

Tronox Joint Agency Stakeholders Meeting Summary

Wednesday, November 14, 2018 8:30 – 5:00

Thursday November 15, 2018 8:30 – 4:00 pm

Toney Anaya Building

2550 Cerrillos Rd, Santa Fe, NM 87505

Overall Outcomes for this meeting:

- 1) Review current financial and project status
- 2) Provide update on schedule to meet IG commitments, San Mateo Basin and Uranium Commission
- 3) Have an opportunity to identify and discuss Mine clean-up decision making process
- 4) Focus on technical information and questions relating to San Mateo Creek Basin Phase 2
- 5) Receive information on Evapotranspirative Covers

Representatives from the following agencies attended the meeting:

- Navajo Nation Environmental Protection Agency (NNEPA)
- Navajo Nation Abandoned Mine Lands (NNAML)
- Navajo Nation Department of Justice (NNDJ)
- Navajo Nation Office of the President/Vice President (NNOPVP)
- New Mexico Environment Department (NMED)
- New Mexico Mining and Minerals Division (NMMMD)
- U.S. Environmental Protection Agency Regions 6 and 9 (U.S. EPA)

Participants: see sign-in sheet¹ (p. 29 – 33)

Summary

Approximately 35 people gathered on November 14-15, 2018 in Santa Fe for the Tronox Joint Agency Stakeholders Meeting. The focus was on forward planning, including identifying projects and key activities for each organization and area for FY19; planning for agency administration changes; continuing the discussion on remedy options; sharing updates on the Uranium Commission; and working towards agreement on risk evaluation factors.

Action Items Identified during the Meeting (NOTE: Items in red are ongoing from previous meetings)

What	Who	By When	Status
1. Administration Transitions:			
a. Provide information for initial briefings.	Chip Poalinelli and Kevin Shade	December 2018	
b. Schedule Region 6 and Region 9 discussion call.		December 2018	
c. Share information with Navajo (to Nina).	R9 (Priscilla Tom)	January 2019	
d. Share information with New Mexico (to Holland and Kurt).	R6 (Kevin Shade)	February 2019	

¹ See Attachment 1 to this document.

What	Who	By When	Status
g. Include warning on agency website.	All agencies	ASAP	
14. Contact Cortasha (CUpshaw@navajonnsn.gov) if interested in participating in one of the upcoming STEM events at local schools.	All	ASAP	Ongoing
15. Follow up with Nona Baheshone (Diné Uranium Remediation Advisory Commission) to find out the next steps and timeline for Uranium Commission and Medicine Men Association and report at the next Tronox Meeting.	Harrison Karr	December 15, 2018	
16. Suggest that the Uranium Commission hire a community involvement person who can assist with outreach and community meeting preparation.	Harrison Karr	December 15, 2018	
17. Follow up with Nona on development of specific guidance on incorporating TEK into the cleanup process and identify possible TEK workshops for other groups including Tronox stakeholders (possibly coordinate with Risk Assessment Workshop #10).	Harrison Karr and Kevin Shade	?	
18. Begin discussions on creating a visual/pictorial of alternatives (using Uranium Commission presentation as a starting point).	Mark Ripperda (Lead), Chip Poalinelli, Secody Hubbard, Dariel Yazzie, Lillie Lane, Binod Chaudhary, Cortasha Upshaw and Madeline Roanhorse	December 11, 2018	
19. Explore the possibility of a Navajo AUM conference.	Melvin Yazzie (Lead) Chip Poalinelli, and Dariel Yazzie	December 31, 2018	
20. Check room availability for the first week of April.	Dariel Yazzie (NN) Kevin Shade and Chip Poalinelli (ABQ)	November 30, 2018	Meeting Postponed

What	Who	By When	Status
21. Deliver draft action items and Manager's meeting notes to USEPA: a. USEPA to review/revise. b. USEPA to send final to group.	Lori Lewis and Gabe Anderson	November 21, 2018	
22. Deliver draft notes to USEPA: a. USEPA to review/revise. b. USEPA to send final to group.	Lori Lewis and Gabe Anderson	November 29, 2018	

Opening – Lori Lewis (Facilitator)

Lori Lewis welcomed meeting participants to the Tronox meeting and invited each organization to provide opening remarks.

Welcoming Remarks and Introductions

- Lori Lewis (Facilitator) welcomed everyone and led introductions.
- Bruce Yurdin (NMED) shared his thoughts on the great turnout, remarking that it is wonderful to see. He thanked the group for coming. We have four local folks that can help with any Santa Fe-related requests (navigating the area, places to eat, etc.)
- Dariel Yazzie (NNEPA-Superfund) said it was good to see everyone, and good to know everyone arrived safely. It was nice drive to get here, and he was able to see some family on the way, which is always good. He has come to the area often in the last few years. As far as what we are here for, we bring our Navajo group with the intent of listening and bringing information back to community members who cannot be here. When we speak, that is who we are speaking for. We are here to speak for the Navajo, that is what we do and it is what we are tasked to do. Thank you all for bringing us here. He is looking forward to the progress we are all working towards.
- Nina Chester (NNOPVP) thanked everyone for being here today. She will take relevant information back to the President.
- Madeline Roanhorse (NNAML) thanked everyone for coming and is looking forward to a productive meeting.
- Ben Banipal (USEPA Region 6) said it was good to see everyone. We have come a long way. Of course, there will be bumps in the road, but we will get over it and it will be okay. We had an IG audit and received positive recommendations, and are looking forward to a productive day.
- Sean Hogan (USEPA Region 9) shared that Will Duncan will not be able to make it today. Sean and Sona Chilingaryan (USEPA Region 9) are here in his place. It is too bad since it would be his first time as Region 9 Section Chief. Sona was the acting Section Chief. There has been a lot of progress since the last meeting. He is looking forward to good discussions and is glad to be here.
- Holland Shepard (NMMMD) explained that NMMMD does the permitting of all of the hard rock lines. We have been participating in this process since January of 2015. It is nice to see familiar and new faces. There is lots of interest in the process. Our interest lies in what is going on in New Mexico, and in getting [licenses, permits] for mines.

Review Agenda and Logistics

- Lori walked through the summary of sessions for the day from the agenda, including short breaks in the morning and afternoon and 75 minutes for lunch.
- The focus is more programmatic today and tomorrow is more technical.

- Holland introduced Fernando Martinez (NMMMD) who is the Mining Director for the state of New Mexico.
- Fernando commented that the turnout is great to see. It is nice to work with the other agencies. He was happy to see so many were able to make it. We are really happy to be a part of this process as well. A lot of major players are here. He is happy to see everyone.
- There are Post It note pads around the room. If something should come up during one of the sessions for the bike rack or a future discussion, please write it down.

Announcements and Updates

- Lori commented that she is a neutral facilitator and will try to move the process along impartially.

Review Action Items from Last Stakeholder's Meeting – Chip Poalinelli (USEPA Region 9)

Review Action Items from Last Meeting

- Please see page 2 of the pdf file for presentation details— Tronox NAUM Nov 2018.pdf.
 - At the last meeting, we talked about the Executive-level meeting.
 - Sona suggested that the managers have a sidebar about this during one of the breaks.
 - The idea was that our directors and higher-ups could start that dialogue and could already have a working relationship so we could take them the information and they could have a constructive dialogue at their level.
 - Side bar group should consist of agency managers.
 - Some of the people may not be able to attend.
 - Holland asked if there was a middle managers-level meeting group? The last meeting was in July, and on the 2nd day there was a mid-level managers meeting and a handful of people in the room attended. To prepare for any executive-level meeting Chip Poalinelli (USEPA Region 9) and Kevin Shade (USEPA Region 6) would have to pull in topics and facilitate what was being communicated before the executive-level meeting.
 - Another understanding was for escalating issues to the executive-level; part of the mid-level manager's meeting purpose was to determine what should be escalated.
 - Lori clarified that the next step is not having the executive meeting; but is defining what the meeting and preparation for that meeting would need to include. The group also should consider things like how to deal with transitions, etc.
 - The sidebar is to discuss when we can have that meeting and set a timeline, it is all currently up in the air.
 - Fernando would like to have the meeting sooner rather than later.

Sidebar for Executive-level Meeting: Managers from All Agencies

Purpose is to discuss timeframe between Navajo Nation and the State of New Mexico.

- Notes provided separately to managers in attendance.

Financial Update – Chip Poalinelli (USEPA Region 9) and Kevin Shade (USEPA Region 6)

Purpose: Update Stakeholders of current balances of Tronox NAUM Settlement Funds, discuss quarterly reports, and answer any questions. Stakeholders will understand current settlement balance and expected future obligations to fund ongoing projects.

Financial Update

- Please see pdf file for presentation details – **Tronox NAUM Q4 Report Updated2.pdf**.
- Chip Poalinelli provided the following financial update:
 - There are quite a few numbers and figures so we will keep it at a higher level.
 - Page 2 gives a brief description of each financial line item addresses concerns and comments about understanding abbreviated accounts.
 - The amount of interest accrued is now included due to a high number of requests regarding the accrued interest on the Tronox money.
 - Chip expects to get another annual report out in the next few months.
- Lori instructed the group to feel free to contact Kevin or Chip with any questions.
 - The interest has gone up this year, but Chip will need to circle back on exact percentage.

Tronox Project Update – Chip Poalinelli and Kevin Shade with updates from NNSFP and NNAML

Purpose: Update Stakeholders on Tronox NAUM program accomplishments, review project timeline, and answer any questions. Stakeholders will understand completed projects, status of ongoing projects, and expected future projects.

Tronox Project Update:

- Please see pages 6-9 of the pdf file for presentation details— **Tronox NAUM Nov 2018.pdf**.
- The field window for seeing the Mexican Spotted Owl is closing due to the cold season. We will work with Fish and Wildlife.

Clarifying Questions, Discussion, Check for General Agreement

- Melvin Yazzie (NNAML) asked if the Cove presentation was provided to the chapter? It was confirmed that the chapter did receive the presentation.
 - Did you provide the CSM Cove technical model to the chapter?
 - No, but we will look to schedule.
- **Action Item: Chip will provide a Cove CSM presentation at a future Tronox meeting.**
- A question was asked about the status of the portal. It is still available.
- Part of the problem in Mesa 5 is compliance with laws; we did select a contractor who will be starting the 164 process. Since USEPA has a different procurement process, Navajo Nation contractors need more time. It was shared with the group that an effort to reach out to Navajo businesses in Church Rock was made.
 - Navajo businesses need to be given more time and more information. This is the work to get them a home.
- It was shared that the intent is to contract Mesa 5 with a Navajo woman-owned contractor.
- Melvin thinks of last season (summer 2018) as a lost season due to the missed opportunity to bring on Navajo contractors for RSEs. He did not see NTU staff all season.
- There is a quarterly report on Navajo employment and training that will be sent out in a couple weeks, by the end of November.
- **Action Item: Kevin and Chip will send out the Navajo Employment and Training Report.**

- Chip mentioned contracts and work provided by Navajo contractors, but agreed there is opportunity for hiring more.
- Section 19 was sold off as ranchettes and as a result, we no longer know who owns them. Without signed access agreements, EPA cannot go out there. Region 6 is working on methods to get out there. There are options and they are working with DOJ and Courts.
- There was a questions about expenses in the handout: Kevin clarified that the expenses include salaries and travel.
- Sonya Chilingaryan commented that it may be helpful for Dariel to share a little about health and safety.
 - This is on the agenda for tomorrow. Dariel agreed and prefers to discuss this tomorrow.

FY19 Project Proposal Overview – Chip Poalinelli

Purpose: Present the Final FY19 Projects with the Stakeholders to meet the commitment made to President Begaye during Region 9/Navajo Nation Consultations. Proceed with Funding Memo for FY19 Projects.

- Please see slides 10 – 16 of the pdf file for presentation details— **Tronox NAUM Nov 2108.pdf**
- Chip provided a brief introduction discussing the added step of government-to-government coordination.

Clarifying Questions, Discussion, Check for General Agreement

- It would be appreciated to learn a rough estimate of total cost.
 - If you go to the quarterly summary, you can take the \$7 million plus the 13-15% for labor and it would give you a rough estimate.
 - It would be nice to have total cost included in the briefing.
- **Action item: Chip and Kevin will add total cost to proposed projects (other than contracting).**
- Will all of the RSEs be complete by the end of the year?
 - Yes, they will be completed within the fiscal year, so all will be done in the next couple of months.
- How many mines are up there total?
 - 34 Tronox, 9 Cyprus and 9 other mines.
- Are there any plans to work with Cyprus?
 - In cases where we can collaborate, we do. They benefited from the road clearing, but they have their own contractor and their own EE/CAs.
 - We find opportunities for economies of scale.
- What about the other 9 mines?
 - Right now, there are not funds or responsible parties.
- Does it make sense to include a future agenda item to discuss the other mines?
 - Yes.
 - Is it better to discuss with this group or at the Quarterly meeting?
 - At the Quarterly meeting.
- Does Linda Reeves still have the responsibility of oversight for Cove?
 - Yes.
 - There should be a conceptual Cove model.
 - This is a good point, Tronox has the lead, and Cyprus is using our data and we are using their data by pulling it into our RSE.
- Has the CSM ended?

- No, the CSM is a living document.
 - It should be updated and the pathway should/will be re-evaluated.
 - These are questions for the CSM briefing – Chip would like feedback on this.
 - USEPA went an additional mile down from each mine and took water samples, so there is more data to add to the CSM.
- The CSM is part of the risk assessment.
- Are these projects part of the activities or will they be part of a separate contract for someone else?
 - It fits within the scope of work. We would have to present the project and they would need to accept it, but it is within the scope of work.
 - A price will be negotiated, for now these are just estimates.
- How much more data will the funding being discussed pay for since, in Cove, a lot of the site is in the same environment?
 - It will be very specific. The goal is to make sure we know everything and we have considered the long-term O&M. We had 34 different locations in Cove because the lithology changes and we need to get 1950's and 1960's data into the database.
- Will there be a 3-dimensional (3D) model?
 - Yes, there will be a 3D model.
 - In response to questions about drilling, Chip said that will be considered, and it is a good point.
- The data model will need to include all lithologies. For example, the sites on the left-side of the mine may be different from sites on the right.
- We will incorporate all of the data we have into the model.
- There is nothing definitive other than the well water that was sampled is contaminated. There are no operable wells being used for human or livestock consumption. Livestock wells that were sampled now have signage and are closed off.
- As for the treatability study, what is the difference between encapsulation and other studies?
 - We would want some more information using the soil samples we have, but will not propose a solution if it is not feasible.
- Would it be helpful to know depth of groundwater?
 - There are about 15-18 elements that are important in citing any type of lithology; there is a standardized list that you go through. It should pick up faulting, layers, permeability, etc. It is different from just a ground water study. Fault lines are a consideration.
 - How do we get all of the information?
 - It should be from a geologist. USGS is providing data along with other sources. (e.g., gamma ray neutron logs, etc.)
 - This is why we are conducting the lithology study.
 - Can we get the information without doing all of the testing?
 - No. One of the things we are seeing in Ambrosia Lake is the remedy is beginning to fail and water is starting to escape.
- Lori asked the group to save the technical questions for tomorrow.
- Chip added that these projects, which will be done in the ecosystem, will be discussed with the group and coordination along with information sharing will happen.
- Chip requested that the group begin thinking about projects through 2020 as he would like to start planning them now.
- Is there still a Cove library?
 - Yes.

Tronox Prioritization Methodology and Schedule – Chip Poalinelli and Kevin Shade

Purpose: Provide Stakeholders with an update on the mine prioritization methodology and schedule to allow for site prioritization and funding allocation to meet IG commitments. The update will include reviewing specific examples of the Mine Prioritization Methodology. Stakeholders will understand the milestones that will be met to allow for Site Prioritization in December 2020 and Fund Allocation in December 2021.

- Please see the pdf files for presentation and worksheet details – **Tronox_Prioritization Edits 11-05-2018 (003).pdf** and **Tronox Prioritization worksheet November 2018.pdf**.

Clarifying Questions, Discussion, Check for General Agreement

- Lori reminded the group to think of their stakeholders and the questions they would have. She explained to the group that we will not have time to address all of the questions the group may have today, nor will we have time to go into as much detail as would be preferred. Instead, she asked that the group use the worksheets and informed the group that questions from the worksheets will be included in the notes.
 - Lori asked for names on the worksheet, but confirmed names will not be included in the notes; names are just for clarification of spelling and questions when compiling the meeting summary, if needed.

Surface Radiation Level Above Background Investigation Level:

- NNEPA asked what is the background?
 - Chip and Warren Zehner (USEPA Region 6) responded that it is UTL 95-95 (found on slide 6 of the attached presentation).
- Laurie Williams (USEPA Region 9) asked how to address areas or mines with different gamma scan results where a percentage of the area has one result and other areas may have different results of the scan (i.e., how will the ranking be weighted)?
 - Warren and Chip clarified this is what is being discussed because there needs to be agreement on the methodology.
 - Laurie commented that there is a possibility that two areas with similar risk could be evaluated differently based on differences in the scan results.
 - Chip and Kevin said these are good questions. These are the questions we want.
- A comment was received point out that we cannot do anything with NORM, but you keep showing maps with NORM. The maps seem misleading.
 - Would this be useful for the community, even if we cannot address it under CERCLA?
 - Yes and no.
 - Darrel agrees that when we have NORM, we have a lot of NORM, and that should not be used in the average.
 - Laurie asked if there is a way to limit the use of NORM as the denominator, but instead use the area of TENORM?
 - It is premature for USEPA to say this is NORM, and should not be labeled as such. Unless there is rigorous testing, it cannot be labeled as NORM.
 - The criteria of factors that were shared do not include NORM versus TENORM; the current criteria just discusses radiation.
 - In Section 32, a community member shared that they saw a crane going down into a shaft and that is when all of the elevated spots in Section 32 were discovered.

- How did you determine that is NORM?
 - Warren explained that everything in purple is what was collected. He provided an explanation of how the data was gathered and provided an overview of the area to the group and where the contamination is coming from and going.
- Can it be definitively said that the sheet flow etc. are NORM?
 - Warren said the levels are inconsistent with what was seen during the original cleanup. The level of background is just a factor; we can have different discussions on ranking and priority.
 - Chip noted that we really need to be able to determine NORM and TENORM.
- If you were to present this to a Western agency, they would have a fit because it includes so much NORM.
 - Warren clarified that what is being discussed is a factor of 1-3, which can be NORM or TENORM.
- Chip reminded the group that the purpose is to determine how we define our evaluation factors, but it is a good conversation to sort out NORM and TENORM later.
- Harrison Karr (NNDJO) believes there is a way to define the map so that it says, “here are areas of NORM we cannot address, and here are areas we can.” More conversation is needed regarding NORM vs TENORM.

Mitigation to Surface Water Factor

- Laurie asked what factors are being used?
 - Kevin responded that he and Chip are still refining what factors should be used.
- A comment was made that rankings of “high”, “medium” and “low” may not be acceptable; if there is any chance there is contamination it should be considered a high risk factor.
 - Lori clarified that that is about prioritization, not whether or not cleanup will be performed.
 - Chip clarified the reason why there is a need to determine high-priority and confirmed he understood the concern: All water is precious, but does one type present more risk?
- Are we going to look at the volume of water and contamination levels?
- Other factors to consider:
 - All water is precious
 - Volume of water
 - Level of contamination
 - Mobility/slope of landscape/erosion potential/gradient
 - Proximity may not be as important when factored with erosion potential and other considerations.
- How are you responding to other contaminants (e.g., arsenic)?
 - We are addressing other contaminants in the risk assessment(s), to include other metals, yes.
- Distance may not be as critical due to other factors such as preferential channels, slope, etc.
- Potential impact will need to be defined; maybe simplify as “likely” or “unlikely” or something similar to avoid having too many factors or variables to control for when determining risk.
 - One way to capture some of the comments may be to use ‘degree of impact.’
 - There are so many variables, this will become very complex and may not be received well by the community.

- Dariel mentioned that we have talked about many different influences; the drainage that exists there now has shifted into an area that was considered a clean area. Now, that area shows contamination levels. Is that NORM or TENORM?
 - Chip explained it is the application we need to look at.

Impacts to Ground Water

- Kevin explained based on comments, we will no longer look at a “Yes” here as a five, but instead as a ten.

Land-use Scenario

- Chip let the group know that this is an area where additional input is needed. There are differences in collecting herbal medications versus agricultural or grazing use.
- How is Land-use of the site being defined?
 - Is it all areas affected with contamination or is it just the mine itself?
 - Warren commented that you have to have a defined boundary of the site.
 - Harrison shared his opinion to the contrary; the proximity is the risk, not necessarily a “cutoff” boundary.
 - To rank something you have to have a way to define what you are ranking. Maybe there can be a category called other, but you have to define the area that you are ranking.
- The impacted area in Region 6 is very different from Cove. Cove is a heritage sight, it is culturally important, and one of the more beautiful locations on Navajo Nation. The mining companies came in and destroyed it; these impacts are very hard to measure.
 - In Region 6, this is different. It is a case of flat lands compared to Cove.
 - A consideration needs to be made for Heritage sights and National Parks; Cove should qualify as a protected area (legally).
- Vivian Craig (NNEPA-Superfund) in terms of the ranking system, how do we capture fundamental law?
 - During the CERCLA process, Warren found some conflict with Fundamental Law. This will be shared with the group via email.
- **Action Item: Kevin will send out Warren’s slide on Fundamental Law.**
- Kurt Vollbrecht (NMED) agrees with Harrison. When we are talking about people living near a site that is contaminated, these are their homes and we need to differentiate residences from transient use.
 - We need to consider impacted areas and areas in close proximity.
 - It may not even be something that is transient, but the cultural and Fundamental Law portion is where the site itself has taken something away from the family. The mining may have disrupted how this area was used previously for traditional practices. Some families are struggling with lifeways and cannot conduct the ceremonies in these areas any longer. It has taken away the cultural value.
- A family in Section 32 is having serious issues, including health. The family suffered a miscarriage among other serious issues.
- From the CSM, we already know what the impacted area is. It is not one mine site; it is a group of mine sites.
 - We would have to look at the grouping of mines. Some will have the same ranking, for example, Sections 32 and 33. Which contaminated the other? We do not know so we have to group them together.

- The waste is comingled so we would have to group them. This is a good example of where grouping makes sense.
- This will have to be looked at when we get to prioritization. It will not be cut and dry, and will be a difficult challenge. We will not know until we start.
- This is just one tool; we have other tools that will help stakeholders make better-informed decisions. Maybe this is a to-do item; conduct a risk assessment training.
 - Ben Banipal (USEPA Region 6) said if we are going to provide Risk Assessment Training, his top two assessors have done training with tribes and can setup a training.
 - Kevin asked if Dariel could work with Ben to sort out the logistics of the training.
- **Action item: Kevin and Dariel will coordinate to schedule Risk Assessment Training 101/102 for the group at a future meeting.**
- CERCLA, per USEPA, has to be based on risk. We do not know how to assess risk for cultural factors. We know there are a lot of things that go into assessing cultural risk, but for it to work in a risk assessment, we do not have a starting point; this is where we could use Navajo assistance.
 - There needs to be a lot more discussion on this. We will stop for now, but will make a note that cultural risk is not just the current impact but also needs to include historical impact, taking into consideration what can no longer be done due to the impact.
- People in Section 32 have started re-fencing and are hoping to begin working with livestock again. They have told us they intend to start grazing again. There is mixed use on the site; this gets into what percentage is residential? What percentage is grazing, etc.? If you have three factors on one site, how do we weight that?
 - Chip clarified that Section 32 is cut and dry; it is residential.
 - Section 33 is grazing.
 - The conversation was about if sections 32 and 33 would be grouped as residential, the answer most likely is yes.
 - This is why we are using these as an example. We have to decide how to deal with these even though this is just a small two-section site.

Accessibility

- Access can change.
- There also needs to be consideration for the type of equipment that has to get to the site.
- Are we making it more or less accessible before and after the cleanup?
- We are just trying to determine what we are exposing people to. We need to focus on structures because people live there. More broadly, we are trying to convey there are a variety of varying risks.
- We will be talking more about this.
- In the field, there is a better appreciation of cultural risks than what is expected from a doctorate-level risk assessor, but we are nowhere near the comprehension of The Navajo, so we have to pass that on to the doctorate-level risk assessor.

Area of Impacted Material

- This does include vent holes.
- One question from the field is would mine workings be included? There was not an answer, so the question was opened to the group:
 - If the contamination has not affected other features, then why would we include it?
 - We have mine workings that fall into the category of incomplete data as far as contamination, so the question is how do we address this?

- **Another factor to be considered is volume of waste.**
 - Chip agreed, this will be key in determining risk. Does one medium sized waste pile at 10X background equal one much larger pile that is 2-3x background?
- Binod Chaudhary (NNEPA) commented that at Cove, there are four or five groups in the conceptual model.
- Sean asked based on the definition, how do we define the limits of what is included?
 - Sean will provide a note on his worksheet.
- Kurt suggested looking at the combination of area impacted and factor one, the gamma scans.

Overall Prioritization

- Navajo Nation would like another prioritization factor to be proximity to Navajo Nation and its people. These funds were intended for Navajo and should be used to protect our people.
- Will there be an initial ranking?
 - That was not the intent.
 - Now that we have seen the field data in real life, we are able to say, "This factor does not make sense as it is written."
 - How do we rank and how do we group?
 - This will be discussed.
 - When you look at risk, will you look at all of the pathways and will we have the best information?
 - That is correct. What we do not want to do is get to the end of the risk assessment and then decide which mine is going to be first. If we do not think about these things now, then it cannot be passed on to the risk assessors.
 - Is the ranking system fluid and subject to change throughout the process?
 - Yes.
 - Will the rankings change?
 - We are not ranking the mines right now. We are making sure we have the correct inputs. The rankings, once they are determined in the future based on the agreed upon inputs, will not change.
- We are going to look at EE/CAs, risk, and many other factors. This is one of many tools.
 - We cannot say we have one tool that will decide prioritization; it will be a combination of tools.
- You are evaluating all of the inputs and are planning how to balance your resources, is that correct?
 - This is all an effort to determine how to allocate resources once all of the mines have been assessed, 1-54. How do we look the landowners, residents and people near mine 54 in the eye? We have to understand the impact and give the risk assessors the correct guidance.
- When someone is determined to be at risk, we move in a time-sensitive manner, we do not wait on all of these risk factors.
- Lori asked that the group bring this to a close for today, and let the group know they will see this again. She asked the group to look at their worksheets and fill them out.
- Chip provided the next steps:
 - We will take back all of the answers.
 - We will include it in a revised presentation of risk assessment.
 - The revised risk assessment presentation will be sent out in the next couple of weeks.
 - Then, we will discuss this again at the next Tronox meeting.

- Sean suggested maybe further building-out the examples we looked at today and pull in considerations from today's conversation to help see how the data may shake out.

Worksheet Responses

Responses from Stakeholders are provided below anonymously and are in no particular order other than organized by response to each Prioritization Factor (1-7).

1. Surface Radiation Level Above Background Investigation Level

- At this site, there was a lot of wind-blown contamination, so it is not right for EPA to say that this "area" is all NORM. Was background taken [using] the same process at all of these sites (e.g., same instrument type, same statistical methodology)?
- Average level risks de-emphasizing smaller areas of much higher levels. Take into account highest readings, on-site. Average places too much weight on definition of area and inclusion (arbitrarily) of non-impacted/low radiation areas. TENORM is not always a clear-cut determinate (versus NORM). Past disturbance is not always visible. Do we want to justify to the public a decision not to address elevated contamination because there is a determination that it has not been "disturbed?" How do we justify that (especially if it is within the "site")?
- Greater than 7 times above background is why [to] average the whole area. This methodology raises questions. Eliminate the area to TENORM. NORM – TENORM? Being included, communities will not just care about NORM numbers, but just that it is included. Impacts [are] hard to measure! Heritage site! The application needs to be looked at.
- Is 50% very high? Is 50% background worse than all at mean? How can you take small areas that are very high level into account when you have a large site; resulting in a low mean radiation level? What is the "site" for purposes of the mean? Perhaps it should only be "the areas of TENORM?"
- NORM versus TENORM will need to be identified.
- If you cannot address NORM under CERCLA, how does this figure into prioritization? Limit definition of "site" as denominator for calculating "mean" as area of TENORM rather than historical mine claim boundaries. Hard to distinguish between NORM and TENORM sometimes, e.g., windblown contamination.
- Navajo people in general will wonder why an area of land was selected over another, especially if they feel they have ownership over it and/or have designated it for personal use.
- Use weighted average to ensure hotspots are appropriately ranked or considered. Perhaps better to only rank based on size of impacted area and levels. Mapping NORM can be used for informing the community but should not be used for ranking purposes.
- Medicinal plant and water use in ceremonies (plants for ceremonies). Subsistence cultural activities – pinyon harvesting, hunting, wood gathering. Query research on how other regions worked with tribes (i.e., Washington, Alaska, and tribes of New York State). There is a lot of work in this area.
- The inclusion of large areas of NORM on a site with a small isolated area of high concentration can inaccurately describe a "mean" to be elevated, and prioritizing "higher" inaccurately or vice versa.

2. Migration to Surface Water

- a. I do not believe using this as a cookie cutter method to prioritize sites is feasible. The application would [need to] be precise and identified.
 - b. Potential for migration should consider gradient and SW flow path, not simply distance. Is there a flow path? What are contaminant levels?
 - c. Volume of water – Contamination levels – All Water is important (maybe weigh it more heavily) – Other constituents (e.g., arsenic, other metals for non-cancer risk) – Flow-path as opposed to distance – mobility of material (look at mobile fraction) – Degree of impact on surface water (subjective).
 - d. NORM will be an issue.
 - e. Can we consider degree of impact? What if water is uphill, within 200 feet of a mine? Will you consider proximity/volume of water versus volume of contamination? Perennial versus Ephemeral. Will you use the degree of surface impact in terms of elevating levels of contaminants?
 - f. Degrees of impacts migration? Prioritization: Volume or volume of contaminates? Magnitude: More weight [than] other contaminates?
 - g. Per Vivian's comment, this factor should be heavily weighted in prioritization. Also, include consideration of volume of water contaminated and level of contamination found.
3. Impacts to Ground Water
- a. Yes/No ranking.
 - b. Ground water studies are expensive. How will the impacts be determined?
 - c. Ground water wells should be installed to confirm impacts exist.
4. Current Land-use
- a. Define "Land-use." What if the land is not used as it used to be due to the mining operations and now that waste exists and families feel they are suffering spiritually due to that?
 - b. Residential needs to consider those living "near" the site. "Near" the site would need to be defined though.
 - c. Cultural risk, EPA cannot calculate it because [they] do not have [the] information. Can calculate residential grazing, commercial, etc. Use the most conservative land-use for ranking area of impact. How do you explain this to the risk assessor?
 - d. All factors are important, e.g., residential, cultural, agricultural, grazing, and recreational.
 - e. Current land-use of site including all areas currently impacted and potentially impacted and areas in close proximity where land use may result in exposure and human health and/or environmental impacts and cultural impacts.
 - f. Residential, cultural/agricultural/grazing, recreational, different uses of land, ranking to TEK and Dine Fundamental Law. Consider Proximity and Lifeways. One-mile boundary.
 - g. Use proximity to mine or contamination rather than land-use "of the site." The latter sounds like a bright-line basic on site boundary, which may not reflect risk to, [for example], residents who are often off-site but very near site boundary.
5. Accessibility
- a. Access can change. Response equipment needs – pre-remediation access versus road building for response.
 - b. Access may change, [for instance], build new road or trail. This may be better coupled with number 4 – is land-use expected to change?

6. Area of contamination

- a. >50 acres, 25 to 50 acres, 10 to 25 acres, <10 acres, no impacted materials on site. Volume not a risk factor. Two or three feet deep of waste material does not pose a risk. Volume of waste is more for cost. *Offsite disposal.
- b. This ties into item number 4.
- c. Estimated area of surface contamination based on exceeding background and/or risk-based cleanup level.
- d. Similar to number 1, consider weighted evaluation. Low-level contamination versus high-level. Perhaps couple with number 1? Area (x) Concentration = Rank?
- e. Would mine workings be included? Yes, subject to subsidence. Incomplete knowledge of mine workings. Surface soil impacted only? Weighted to level of contamination.
- f. Same as number 1. (NORM versus TENORM will need to be identified).
- g. Mine area is a mine area. Mine workings should all be included, regardless if below the background, like a shaft or drill hole that [is] less than background. Could pose safety hazards and still be addressed.

7. General Prioritization Process

- a. Impacts to Navajo people and land should be a factor all its own.
- b. Proximity to residences? (If off-site but nearby, these would not be captured in current land-use). Proximity to and impact upon Navajo land or residents. Navajo Nation position is that mines impacting Navajo Nation should have priority for Tronox funding.
- c. The Navajo claim that sites on and impacting Navajo Nation should be addressed first and foremost.
- d. Want impact to Navajo people on Navajo Nation as a prioritization factor. Would there be an initial ranking? No. Continue to refine these factors; there will be a longer session at the next Tronox meeting. Use other examples to lead next discussion.
- e. I feel it would be seen as an injustice if contamination that is affecting people and their homes, water and resources [were] not cleaned up, regardless of CERCLA.
- f. Grouping. Comingling. Area of contamination and a rule with high radiation numbers.

8. [Suggested on one worksheet] Proximity to Navajo Nation Communities

- a. We believe Tronox funds are for cleanup of mines near Navajo Nation communities.

San Mateo Creek Basin – Overview of Enforcement and NPL Process – Kevin Shade

Purpose: Provide update of the San Mateo Creek Basin Site (enforcement and NPL listing) so that Stakeholders will understand the current status of the Site.

- USEPA received a letter from the State of New Mexico. The President of Navajo Nation also conveyed his support.
- General notice letters were sent to Harrison Karr (NNDOJ), Dr. Benn, and Dariel. These are available upon request.
- How many sites are included in the notice?
 - In the Basin there are 85 mines; at least 55% of the mines are covered by operators.
- **Action item: Kevin will provide distribution of San Mateo Creek Basin PRPs.**
- Where is Region 6 looking for the remaining PRPs?
 - Those are orphan mines but we are hoping to begin working on identifying PRPs. However, there are some mines where the operators no longer exist.
- On September 16th, we released the San Mateo Creek Basin Phase 1 report. Phase 2 was released in October. Mark Purcell (USEPA Region 6) has DVDs if anyone would like a copy of one. There may be questions that we do not get to or would be more appropriate in a longer forum. We can discuss more in the future.

San Mateo Creek Basin Phase 2 Report – Overview and Q&A Session – Mark Purcell and Kevin Shade

Purpose: Present an overview of the findings of the Phase 2 Ground Water Report and respond to technical questions Stakeholders may have. Stakeholders will gain an understanding of known contamination of the San Mateo Creek Basin and how it may impact their communities.

- Please see the pdf file for presentation details – **November 14 2018 - Tronox Quarterly Meeting - Phase 2 Report.pdf**
- Phase 2 is much larger than Phase 1. It is estimated to be around 100 times larger.
- Mark Introduced himself, he is from Region 6 and is a geologist.
- Marked asked the group to not use the September 28th report because it is missing a conversion from meters to feet in certain parts. The revised version from October 1st is the corrected version.
- What kind of treatment did they use to treat the water in the 1970's?
 - This can be found in the report in section three.
- Lori let the group know the presentation will be included in the notes.
- Are all of the layers of bedrock able to absorb water?
 - No, not all are aquifers.
- An abbreviated version of this briefing was provided to the community in October.
 - Was anyone from Navajo Nation present?
 - No, not according to the sign-in sheets.
- Laurie added that the levels of alternative concentration limits in the presentation are not the end of the story.
- What is the closest aquifer to that site?
 - There are several. Westwater and Dakota are two examples, although some of the Dakota wells do not seem to be impacted.
- What are the operations at Rio Algom?

- It is not an active mill. It is thought that they are preparing an abatement plan, and are doing a number of things with the State of New Mexico. It is a potential NPL site. There is no pumping operation currently.
- Do you have enough information to determine if contamination is from the mill or from the mine?
 - No, not at this time.
- Originally, we had thought we would do a three-phase model. However, phase 2 grew exponentially to address what we would be looking at in phase 3. We did not want to use Tronox or EPA taxpayer money, so we are looking for the PRPs to fill in the data gaps.

Day 1 Closing – Lori Lewis (Facilitator)

Lori Lewis reviewed action items before requesting closing comments by leaders from each organization.

Review Action Items

- See the table at the top of this meeting summary.

Closing Comments

- Lori walked through the agenda for tomorrow, November 15th.
 - Kevin made an announcement:
 - Knowing the agency transitions that are coming up, we are looking at the first week of April for the next Tronox meeting.
 - Dallas was suggested as a possible hosting location.
 - Kevin does not want to put the extra travel and cost burdens on anyone, and has some concerns about hosting in Dallas since they will be relocating to a new building around that time. He will look to make sure there will not be a conflict with the move.
 - Kevin requested that if Navajo Nation or New Mexico have conflicts, please let him know.
- Lori thanked the group for their participation.

Day 2 Opening – Lori Lewis (Facilitator)

Lori Lewis welcomed meeting participants to the Tronox meeting and invited each organization to provide opening remarks.

Welcoming Remarks and Introductions

- Lori led introductions and noted that it was nice to have a good number of people from the State of New Mexico in attendance.

Review Agenda and Logistics

- Lori walked through the summary of sessions for the day including breaks and 75 minutes for lunch.

NNEPA Project Update on Health and Safety – Dariel Yazzie

Purpose: Present information relevant to protecting the people who are sent to sites where blasting caps have been found; the community, who may not be aware of blasting caps; and to discuss liability for the blasting caps.

- Please see the pdf file for presentation details – **Final_Thursday – 1.pdf**
- Chip provided opening remarks informing the group that blasting caps have been discovered and there has been coordinated efforts between Navajo Nation and the Farmington Bomb Squad to remove or detonate the blasting caps in place when they have been discovered.
- Laurie asked if anyone thought it is appropriate to put up warning signs.
 - Signs have not been put up yet because they would have to be put up everywhere. The caps are very small and can be transported in many ways (e.g., waterways, weather, etc.).
 - Chip has experience with cleaning up ordinance for the Department of Defense (DoD), and at DoD they would put up large posters with information warning the public of the dangers of undetonated ordinances.
 - Dariel agreed with the idea of putting up signs and posters to warn people of the dangers.
- What is the difference between blasting caps and dynamite? What is the level of danger? Can they be detonated by stepping on one?
 - Blasting caps are usually used as a primary charge that detonates dynamite. They are capable of causing severe harm.
 - In response to whether or not blasting caps can be detonated by stepping on them: Yes, they can be detonated by radio waves, by accidentally stepping on one, and many other ways. They are not difficult to set off. They are powerful enough to blow a hole in a foot, or cause someone to lose some digits.
- Should there be a sign that identifies a POC when these are found?
- **Action item: NNEPA and USEPA will coordinate on sharing information and providing education on explosives to include immediate temporary signage and long-term communication and planning.**
- How did you get the Farmington Bomb Squad to respond? Was it through a MOU?
 - The Farmington Bomb Squad responded when it was coordinated through the Navajo Nation CID as a community service, and does not charge for the service.

- **Action item: Dariel and Chip will draft a SOP on how this process could work going forward.**
- Laurie shared that when she hears that a child could lose digits, she thinks this needs to be addressed **immediately**.
 - This was met with agreement from the group.
- What is the protocol for clearing a site?
 - The only real protocol is to walk the grounds with experienced professionals looking for the blasting caps and taking action to remove or detonate in place. Underground radar will not detect smaller explosives like the blasting caps.
- Vivian suggested maybe there should be a PSA through local news agencies that informs the community that there are ongoing assessments on these lands, because there are a lot of ATV tracks – meaning people may not be aware of the danger. If we communicate it through radio announcements, we can prevent people from being harmed.
- **Action item: Arrange for PSA about blasting caps and undetonated explosives.**
- Have you informed other chapters besides Cove?
 - We have not yet.
- Would it make sense to close the road until the signage and communications are deployed?
 - The community is using the road extensively, so closing the road is not something the chapter wants.
- It was requested that there should be a Navajo Nation-wide notice about hazards at mine sites.
- Another agency to reach out to is the New Mexico Department of Game and Fish because the risk extends to people who hunt and fish on these lands.
- Other means of communicating the dangers and warning the public include putting warnings on all agency websites and incorporating communications about blasting caps into ongoing outreach efforts being made by CICs.
- Dariel would like Navajo AML to assist with efforts. Cortasha Upshaw (NNAML) was selected to be the POC for this.
- The goal is to provide a PSA, in both Navajo and English, to be put out by mid-week next week before the holiday.
- Sona thinks the group can spend at least 30 minutes, if not more, during the meeting next Tuesday addressing these issues.

NNAML STEM Updates – Cortasha Upshaw

Purpose: Present an update on the STEM-sation initiative and recent efforts.

- Cortasha Upshaw provided an update on recent Navajo *STEM-sation* events and ongoing efforts.
 - The focus of the *STEM-sation* events at local high schools is to expose students to different professions and professionals who work on, and with, Navajo Nation providing science-related services and support.
 - The administrators of the schools have been extremely complimentary of these events.
 - The Farmington Bomb Squad was involved.
 - The Department of Energy has participated in these events and brings ground water to show to the students.
 - NNAML brings various types of rocks to show to the students.
 - Melvin and others do a wonderful job of engaging with the students in a very positive way.

- Cortasha invited everyone to come to one or more of these events.
- The events have occurred at four schools, and over 2,500 students have participated in the events this fall.
- Events have been planned through this winter and into spring of next year. The below list includes schools where events have been planned and the month in which the event will be held:
 - Pinon High School – January 2019
 - Thoreau High School – February 2019
 - Window Rock High School – March 2019
 - Granado High School – April 2019
 - Hopi High School – April 2019 (tentative)
- USEPA and NNEPA have many professions that will need to be filled in the future.
- We are looking for longevity and stability.
- We would really like the involvement and support from USEPA moving forward because it will help our Nation in the future.
- Laurie asked if there has been any consideration for including lawyers.
 - Indirectly, yes. We tell the kids all of the topics are STEM and yes, having a lawyer to explain all of the projects would be great.
- How are the schools engaged in order to schedule and coordinate?
 - We contact the schools and present what the initiative includes and what the benefits for the students would be.
 - We set up our event in gymnasiums and rotate math and science classes into the gym during class periods.
- The schools have been very pleased and teachers have told us that the students are excited to participate. After the events, the students are talking about the organizations and STEM disciplines.
- Melvin shared that they are trying to relate their experiences and open all available avenues to encourage STEM for the students to help support the next generation.
- Everyone is encouraged to contact Cortasha if interested in volunteering at one or more of the events: CUpshaw@navajo-nsn.gov.

Update on Navajo Uranium Commission – Harrison Karr and Darriel Yazzie

Purpose: Provide update on the Uranium Commission's key current issues, activities, and questions; and identify opportunities for the Stakeholders to assist the Commission in carrying out its duties.

- We have two representatives of the Commission here in Darriel and Madeline Roanhorse (NNAML).
- The inaugural meeting of the Commission was in January 2018; we have had a meeting every month since then.
- All of the meetings were held in the communities.
- Eventually we will expand outside of the uranium-impacted communities.
- We had a good turnout in Cameron and at Cove; members have provided good comments and feedback.
- There have been some very tragic stories as well where families have discussed the loss of loved ones and the overall impact to their lives.

- Traditional ecological information has been shared repeatedly at these meetings. We are hoping to work with USEPA to share the ecological knowledge. Both Region 6 and Region 9 have been very good about including this information into the activities and reports.
- The only semiofficial position of Navajo Nation is that all of the mine waste should be disposed of off Navajo Nation. Former President Shirley provided this position.
 - This creates an issue with backfilling mines if they are on Navajo Nation.
- One of the tasks of the commission is to develop a formal process of disposing of mine waste that is on Navajo lands. Our next step is to work on drafting this process/policy and presenting it to the leaders of the Nation. We only serve in an advisory capacity; we have no power except to advise Navajo leadership on policy/procedures. We have repeatedly asked the council for representation that is currently void.
- Dr. Benn is a political appointee who may, or may not, be kept on by the new President.
- Some officials have the authority to appoint representatives to attend the meetings for them.
- There are two meetings planned in the near future. The November meeting was moved to Sweetwater, the December meeting is in Haystack and the January meeting is in Sanders. Meetings are planned through the spring and summer of 2019.
- The commission hopes to have a recommendations paper drafted sometime next year.
- As we are looking at the disposal options and engaging with the community, we are taking an approach that has not been included in years past; we are including TEK and Fundamental Law. This has produced a very insightful return. The more we talk about these, the community has come back and said, "These are materials that came from our lands. Why would we want to move it elsewhere? Why do we not return it to where it came from?" This is in contrast to former President Shirley's comments, and a change in the approach that has come directly from the community. The elders are talking and they are sharing how this has impacted them spiritually, culturally and how it has impacted their families.
- In Cove, many of the community members have expressed opposition with driving truckloads of contaminated material through the community; they would prefer for that not to happen.
- Additionally, there have been conversations about bringing in medicine men to bless and address the impacted material and land.
- Is there a timeline?
 - No, not at this time.
- Cleaning up industrial processes often involves additional industrial processes; this is a great conversation because it is investigating ways to heal the earth in a holistic manner.
- Kevin is in communication with Nona Baheshone (Diné Uranium Remediation Advisory Commission) and they will follow up after the elections.
- Madeline commented that the concerns were about the cleanup; the studies that are ongoing indicate that they want the cleanup done.
- Nina believes it would be helpful to tell the community members as early as possible that the comment period is coming up and when. When the elders come to the meetings they are hesitant and wary to share; they believe if they share once, something will be done. One of the concerns we have is we do not want to frustrate them; if they continue to share their stories and do not see progress it is disheartening.
- Sona suggested possibly letting the medicine men check-in with the Uranium Commission. It would be helpful to have a timeframe so we could facilitate that happening.

- **Action item: Harrison will engage with Nona to establish a timeline to check-in with the medicine men.**
- It was suggested that hiring a communications outreach person would be helpful so that over the next few years people could have their comments included in the report. This would mean possibly adding a CIC to the Uranium Commission.
- **Action item: Harrison will look into adding a CIC role to the Uranium Commission.**
- How will Harrison get this information to the group?
 - It is possible that he can provide an update at the next quarterly meeting.
 - We have a protocol and distribution list, so if anything needs to be shared we can work on that.
- Darrel provided additional input sharing that the commission is looking at engaging the medicine men when they are looking at what the process will be and how the cleanup will be conducted. In our discussions with Elsa Johnson (USEPA Region 9) and the trustees, we feel that the inclusion of traditional practitioners and Fundamental Law needs to be done now. It is a spiritual undertaking, it is not just the effects of uranium, but it is also the potential of existing conditions in these communities. As an example, there are trees that have been touched by lightning, and we need to have ceremonies to address this. When translated into Western science, the big concern is cancer; we do not want to expose our people to things like this. Anytime we have something this powerful, there will be people who want to abuse that power. Witchcraft was identified to exist in that area, and for us to put our people out there is not something we want to do. When we bring traditional practitioners onboard, we want to do it from the outset for protection to safeguard our people.
- Warren added that we are talking about TEK in the assessment process. The way he does RSEs and EE/CAs is to take TEK full circle. We are disturbing the area again and we have to return the land to the preferred ecological state. Many considerations come into play. In the end, we have to look at the back-end reclamation that needs to fit within the greater concept of TEK. I know we have talked about the front-end, but has anyone addressed the back-end and how TEK addresses the reclamation process?
 - We have not but that is an excellent point, thank you.
- **Action item: Harrison and Kevin will look into incorporating TEK into cleanup planning.**
- What is TEK?
 - TEK is the acronym for Traditional Ecological Knowledge. The idea of TEK is addressing environmental issues as they pertain to the Navajo people, their core value of being a part of the environment and the environment being a part of us. For Navajo, the environment is an extension of our being. With that understanding, TEK informs the work that we are doing. This includes teachings, prayers, songs, traditional medicine and many other aspects.
- There is a need to make considerations for sacred sites. If they are reclaimed, it will change the makeup of the site.
- How does this apply to sites that are not on Navajo Nation?
 - The understanding is it will still apply because other sites still have an impact on Navajo Nation. Other tribes may want to be involved as well.
- The experiential element may be good to bolster the understanding among the agencies.
- **Action item: Harrison and Kevin will look into conducting a TEK workshop for a broader audience for education and awareness, and possibly coordinate with the Risk Assessment Training.**

- The Mohawk Tribe and another tribe from Washington State have pushed TEK to Federal agency partners. Maybe Navajo Nation needs to do the same since we are a large tribe and it would help the communities and Mother Earth, who have suffered.
- One of the things USEPA is trying to understand is the cultural implications of the land. When we are moving the dirt we need to be aware of areas of sensitivity.
 - Communication is key; there is a need to gain approval before taking actions that could be seen as disrespectful or culturally insensitive. The big piece is communication.

Evapotranspirative Covers – Dr. Joseph Marcoline, Hydrogeologist (NMED)

Purpose: Present an overview of evapotranspirative (ET) cover systems and how they can be used to address risk to human health at mine sites.

- Please see the pdf presentation for more information – **ET Cover Systems.pdf**
- Would there be actual field work and/or experiments conducted, or would the main method to determine feasibility be conceptual models and graphs?
 - Field performance monitoring and measurement will be conducted.
- Is there a minimum thickness requirement?
 - It depends on the material; there is not a minimum that is known, however there may be a maximum.
 - The design, construction, and thickness are all very important factors that apply to ET Cover Systems.
- There were conversations about a minimum thickness of three feet in the past. Additionally, we want these to last for a very long time. The idea that they will last forever is unrealistic because erosion does occur, but we want to make sure these last for as long as possible.
- In this area, there is not much evaporation three feet below the surface.
- After installation, how long does it take to measure performance?
 - We begin measuring performance instantaneously.
- Many participants in the group shared their opinion that this was a fabulous and amazing presentation.
- USEPA has used this information before. We have other goals besides the primary goals identified. Have you looked at preventing erosion?
 - Yes, this is a consideration – it is integral to include native life, vegetation and wildlife.
- Has incorporating a radon barrier been looked at?
 - A radon barrier can be incorporated; this kind of work is being done at the Blue Water site. Some of the preliminary work looks very good.
- Is climate change impact incorporated in the modeling?
 - That is a great question, but it has not been included.
- In the design, there were not any signs of rock or biological-barrier. Could that be included?
 - It depends on the goals and needs, but if it is needed to protect wildlife or for other reasons, then it can be done effectively.
- Is there a possibility of taking down the protective fence to allow livestock to feed?
 - There is not a conclusive answer for that at this time. Livestock can cause a lot of damage, but it could be included in the design.
- Erosion is a key concern, because it can erode the effectiveness of the cap.

- Kurt Vollbrecht made the group aware that Joseph (Joe) Marcoline (NNMED) is familiar with much larger cover systems (e.g., Chino).
- What is the corrective action for erosion?
 - That has to be established once we have the performance data, and would be provided to decision makers.
- Do we need bottom liners for protection?
 - The answer depends on the waste material.
 - There has been a significant move away from synthetic liners. Companies will not guarantee these liners beyond 50 years.
 - There is a popular thought that liners would give you a more robust protective system.
 - If the money is there and the community is comfortable with it, Joe would be okay with it.
 - There have been past examples of issues with geo-synthetic liners; often there is more maintenance required.
- There were multiple comments about the risks of adding a liner when there is a slope involved.
- In the last five years, we have seen a lot of success with ETs as opposed to some of the failures in the past.
- Joe is going to look for reliable sources of information where people can find additional information on ETs and will provide that information at a later date.
- If people have additional questions, please contact Joe: Joseph.Marcoline@State.NM.US.

Backfilling Mines – Kurt Vollbrecht

Purpose: Present an overview of backfilling mines with mine waste as an alternative for disposal.

- Please see the pdf presentation for more information – **Shaft Backfill (002).pdf**
- What are some of the challenges you have run into?
 - We need to figure out where groundwater is, among other things. Some mines are thought to be dry shafts, but the histories may indicate otherwise.
- In the Hanover Whitewater area, did they look at over-boring?
 - They did not. One of the things that has been done in the past was sending a camera or other equipment down the hole to determine what is actually beneath the surface.
- Have you used slurries to backfill materials?
 - We have not looked at that, but have heard of it being done.
- There is a difference in how sulfide waste and uranium waste is handled due to oxidation and mobilization of uranium.

Mine Cleanup Scenario – Lori Lewis and Chip Poalinelli

Purpose: Stakeholders will understand the factors that must be considered in making decisions that lead to the identification of a cleanup strategy for a mine site.

- The group completed the exercise “Mine Site Removal Alternative Evaluation.” Please see the pdf document for more information – **Exercise Handouts_UCTraining Tronox.pdf**.
 - Lori ensured each small group was comprised of a technical person, a legal person, a manager, a TEK person, a community person, a fieldwork person, and had diverse agency representation. The groups were balanced as best as possible.

- Chip discussed what went into creating the exercise, mentioning that the scenarios are hypothetical but the photos are real.
- The purpose is to solicit additional stakeholder input, as there are a number of EE/CAs coming in the next year.
- Chip added that this is not a final decision exercise; it is simply looking to gain exploratory insight at this stage.
- Large group conversation:
 - Dariel said there were not enough knowns for us to make an informed decision.
 - It was necessary to fit the exercise within the time constraints, but yes, there are many more considerations that would need to be made. A lot of the missing information is the information that we are trying to gather. There is a lot of data that has to be considered. This exemplifies the challenges of the cleanup and why the CERCLA process takes so long.
 - Melvin commented that the volumes of waste in the waste pile are a very big unknown; there could be 2-3 times more waste than what is thought to be there.
 - One thing to keep in mind is once all of the data comes in, it is difficult to make informed decisions based on the volume of data. Additionally, it has to go out to the communities and many others; it is difficult to weigh all of the information.
 - Effectiveness, implementability and cost all present challenges. It is even more challenging when considering all three factors, including all of the different data and data sources that inform each of the three factors. This all has to be considered in order to evaluate, make decisions, distribute communications and education, etc.
 - We all have an understanding that there is a lot that goes into this process, but in order to complete this exercise we need more information to answer questions and decide what we are going to do to address these sites.
 - It was beneficial to have diverse groups because individuals were able to apply their strengths; this emphasizes the need to have decision makers from different backgrounds.
 - More visual representation of what the alternatives are would be helpful in the future; a visual pictorial of the models was discussed.
- **Action Item: USEPA will begin discussions on creating a visual/pictorial of alternatives (using the Uranium Commission presentation as a starting point) with help from Navajo Nation.**
 - We can use past projects to build a model where we all are wearing our respective hats in order to provide the visual pictorial; it is not that hard but we just need to do it.
 - The technology exists; we just need to figure out how to use it.
 - Chip would like to work with Navajo Nation and NNAML.
 - From USEPA, Chip will be the champion with Mark Ripperda's (USEPA Region 9) help and will seek input from NNEPA and NNAML.
 - Chip would like to use the Tuesday calls to discuss and move this idea forward.
 - Madeline will ask Cortasha to serve on the small working group.
 - Timeframe to begin the discussions is December 11, 2018.
- Final words on exercise:
 - USEPA Region 9 found it very helpful to hear the different perspectives and collaborative talks. This was a great example of how we all wear different hats because we all do have to wear different hats in order to continue making progress.
 - There were multiple comments emphasizing how well Lori did in running the exercise.

Open Technical Discussion

Purpose: Opportunity to discuss any other technical questions that have arisen during the two-day meeting.

- Regarding the blasting caps, it was suggested to update the agency Websites (NNAML, NN, USEPA) as a short-term means to address the dangers.
- Melvin shared that some of the work NNAML is doing involves attending different conferences (e.g., DOE conferences). The thinking is that maybe there needs to be a Navajo AUM conference to bring in groups, possibly over two days: Day one will be focused on what Navajo Nation needs/wants and day two will be for vendors to try to sell their products.
 - Next step would be to talk to Dariel and Chip.
 - Timeframe – report during the next meeting.
- Melvin will be the lead.
- **Action Item: Melvin will explore the possibility of developing and hosting a Navajo AUM conference**

Closing – Lori Lewis (Facilitator)

Review Action Items and bike rack

- See the table at the top of the meeting summary.
- One bike rack item was posted on the wall regarding long-term concerns about the Groundwater in Cove.
 - Chip will discuss with Lillie Lane (NNEPA).
- Kevin is concerned about technical issues at the new facility in Dallas, so maybe the fall meeting can be hosted in Dallas, but not the spring meeting.
- The sentiment of the group is perhaps the Executive-level meeting can occur in April.
 - Because conference rooms are hard to find, it may be good to start looking for rooms now.
- Kevin asked Dariel if there was a preference on where to hold the next meeting. Dariel will look into reserving a room at the Navajo Nation Museum in Window Rock and if a room is not available, then Albuquerque would be the preference. Dariel will follow up after looking at availability.

What worked well:

- The format of the two-day meeting: Having one day dedicated to general information and updates and one day dedicated to technical discussions was appreciated.
- The location was good.
- The group agreed that the facilitation was excellent.
- All of the presenters did an excellent job.
- Many of the group members appreciated the Mine Site Removal Alternative Evaluation exercise.
- The group liked the discussion on cleanup options.

² See attachment 2 to this document.

What can be changed:

- No comments were provided on what can be changed.

Closing Comments

- Nina (NNOPVP) thanked everyone for the time and energy that they put into the work. I appreciate that there are people with TEK and technical knowledge and that your work is helping a disadvantaged people in the Navajo. I also want to say Happy Thanksgiving to everyone.
- Harrison (NNDJO) thanked everyone.
- Dariel (NNEPA-Superfund) finds these meetings productive. We will not always see eye to eye but that is what makes it work. It was said that we all wear different hats, and I agree that we do but with one common goal. I cannot say thank you enough for your work and your efforts. I cannot stress enough the importance of communicating with the Navajo because we are grilled hard on why we are not doing more. The community can be very candid; they can be very hard on us. We are pulled aside by family members that ask, "What are you doing? This is not how Navajo are supposed to work." We all have full plates. My big goal is capacity building. I need more people involved on Superfund. We will take this information back to our communities. Nina, I want to say thank you for stepping up your game and your commitment. You will be missed. I also want to say thank you and happy holidays.
- Ben (USEPA Region 6) thanked New Mexico for hosting. Great location, great food. Thank you for your presentation Kurt. Thank you, Dariel for sharing the thoughts and comments from your community. Happy holidays, and thank you all.
- Sean (USEPA Region 9) thanked New Mexico and thanked everyone for being a participant in these meetings. Thank you to Chip, Kevin and Lori, we have great agendas and planning. Also thank you to Nina; if the next administration has someone as dedicated and committed as you they will be very lucky.
- Holland (NMMMD) thanked everyone for coming. It has been really great to see everyone coming together and working together.
- Kurt (NMED) said he always walks away feeling as though he has learned a lot and it always gives him a lot to think about. I really appreciate having you all here. Anytime you want to come back, I would be glad to have you. In respect to Bruce, he intended to make an opening statement and leave, but he ended up spending the whole day because he was engaged in the process, I think that says a lot.
- Lori asked that everyone have a safe and uneventful journey home. Thank you!

Tronox Joint Agency Stakeholders Meeting: November 14, 2018: 8:30 am – 5:00 pm

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Tronox Joint Agency Stakeholders Meeting: November 15, 2018: 8:30 am – 4:00 pm

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Retired

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Attachment 2: Group Exercise Mine Site Removal Alternative Evaluations

AVM Scenario 1 - Group 1
Evaluation Worksheet (All Teams)

Alternative A - No Action
Alternative B - Backfilling Mine Workings with Contaminated Mine Waste
Alternative C - Consolidation and Capping of Mine Waste in Place
Alternative D - Excavation and Transportation to a Regional Repository
Alternative E - Disposal at a Licensed Low-Level Radioactive (LLRW) Facility

Reasons: Comparable cost, eliminates threats @ site all receptors consolidated long term maintenance, lower haulage cost, TEK, location permitting, uncertain: TEK, location permitting, repairs land → agreement

CRITERIA/ALTERNATIVE	NOTES
Effectiveness	
Alternative A	erosion escalating • some exposure contamination movement.
Alternative B	/
Alternative C	stable protection
Alternative D	
Alternative E	3 No waste on site ↑, haulage ↓
Implementability	
Alternative A	high
Alternative B	/
Alternative C	working on slope continued maintenance
Alternative D	working on slope haulage through town
Alternative E	working on slope haulage through town
Cost	
Alternative A	low
Alternative B	/
Alternative C	initial excavation ↑ movement ↑ Disposal 28
Alternative D	initial excavation ↑ movement ↑ Disposal 28
Alternative E	initial excavation ↑ movement ↑ Disposal 43

Scenario 1

Evaluation Worksheet (All Teams)

Alternative A - No Action

Alternative B - Backfilling Mine Workings with Contaminated Mine Waste

Alternative C - Consolidation and Capping of Mine Waste in Place

Alternative D - Excavation and Transportation to a Regional Repository

Alternative E - Disposal at a Licensed Low-Level Radioactive (LLRW) Facility

ALT D

CRITERIA/ALTERNATIVE	NOTES
Effectiveness	
Alternative A	Not Effective
Alternative B	Not Effective
Alternative C	Effective
Alternative D	Effective
Alternative E	Effective
Implementability	
Alternative A	—
Alternative B	Not Implementable
Alternative C	Implementable
Alternative D	Implementable
Alternative E	Implementable
Cost	
Alternative A	0
Alternative B	0
Alternative C	Excavates: \$25,000,000 20,000,000 } \$27,240,000
Alternative D	Excavates: \$25,000,000 Road 200,000 100,000 haul } 28,300,000
Alternative E	25,000,000 10,000,000 hauling 2,000,000 Disposal } 43,200,000

Team 4 Scenario 2

Evaluation Worksheet (All Teams)

- Alternative A - No Action
 Alternative B - Backfilling Mine Workings with Contaminated Mine Waste
 Alternative C - Consolidation and Capping of Mine Waste in Place
 Alternative D - Excavation and Transportation to a Regional Repository
 Alternative E - Disposal at a Licensed Low-Level Radioactive (LLRW) Facility

CRITERIA/ALTERNATIVE	NOTES
Effectiveness	
Alternative A	not not effective -
Alternative B	N/A
Alternative C	Yes - not effective in short term; less effective in long ^{long} term assume long term effective through O.M. - NV policy against on-site disposal
Alternative D	Yes - more effective -
Alternative E	Yes - most effective - long term take longer to implement - least for short term no trucking waste through NV - not feasible (need clarification)
Implementability	
Alternative A	not yes
Alternative B	N/A
Alternative C	No - policy standpoint but yes - put back in ground & have ceremony
Alternative D	Yes - can haul waste for disposal across NV - better long term maintenance -
Alternative E	yes - " " " " " " " "
Cost	
Alternative A	none
Alternative B	N/A
Alternative C	\$100,200,000
Alternative D	\$181,300,000
Alternative E	\$250,100,000

Evaluation Worksheet (All Teams)

Alternative A - No Action
 Alternative B - Backfilling Mine Workings with Contaminated Mine Waste
 Alternative C - Consolidation and Capping of Mine Waste in Place
 Alternative D - Excavation and Transportation to a Regional Repository
 Alternative E - Disposal at a Licensed Low-Level Radioactive (LLRW) Facility

Team #2
 Scenario #2

CRITERIA/ALTERNATIVE	NOTES
Effectiveness	
Alternative A	Not effective
Alternative B	Not an option
Alternative C	Short term effectiveness, long term risks not handling waste
Alternative D	effective
Alternative E	Long term effectiveness, short term handling risks
Implementability	
Alternative A	implementable
Alternative B	Not an option
Alternative C	Implementable, O&M,
Alternative D	Not implementable Implementable exposing workers
Alternative E	may not be implementable 50k truck loads
Cost	
Alternative A	Cheap
Alternative B	Not an option
Alternative C	most cost effective
Alternative D	between cost of C & D
Alternative E	Super expensive



SAN MATEO CREEK BASIN GROUND WATER INVESTIGATION

2018 PHASE 2 REPORT

Tronox Quarterly Meeting Presentation
November 14, 2018

Mark Purcell
USEPA Region 6

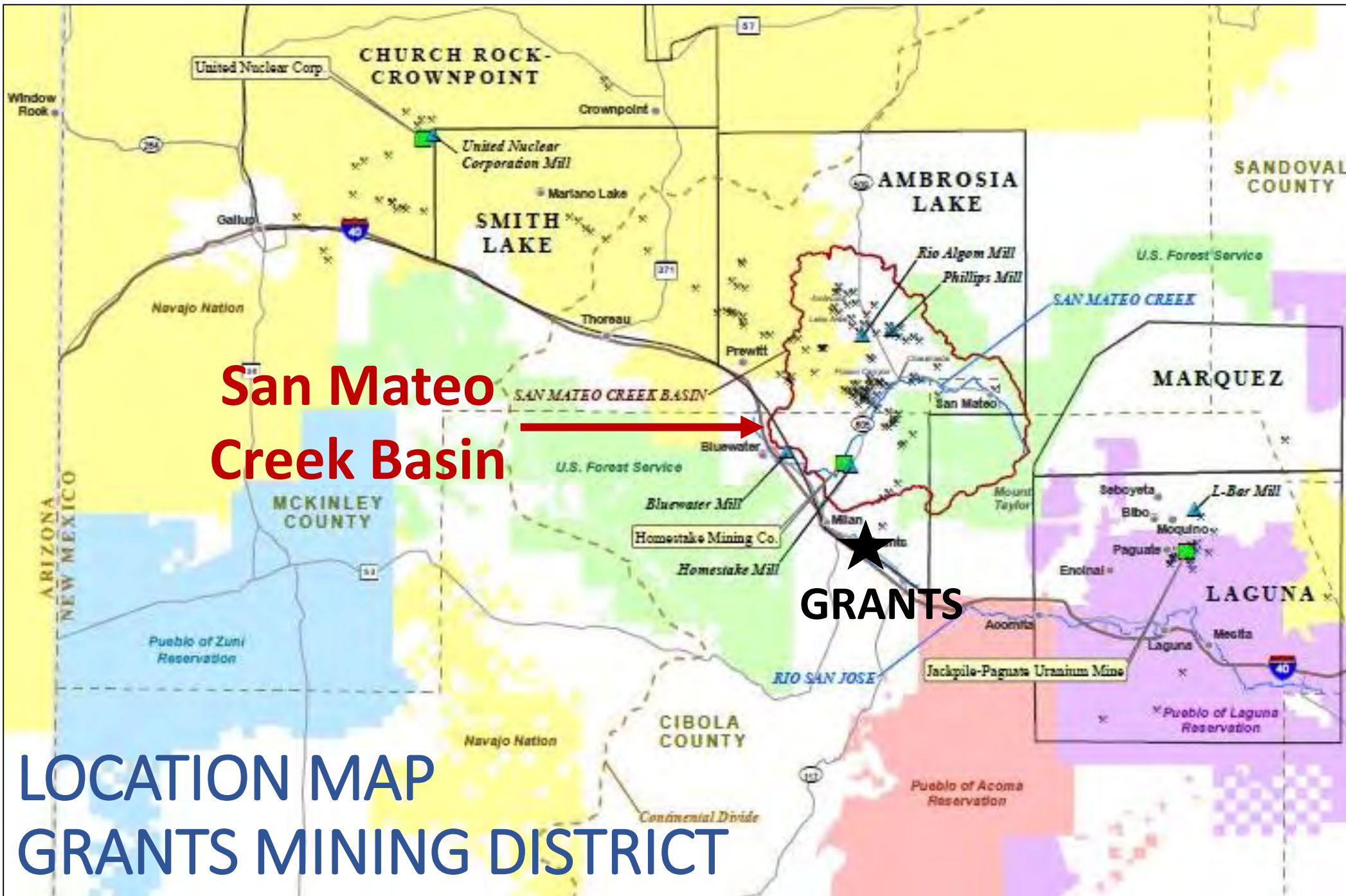
San Mateo Creek Basin

GRANTS

Land Ownership

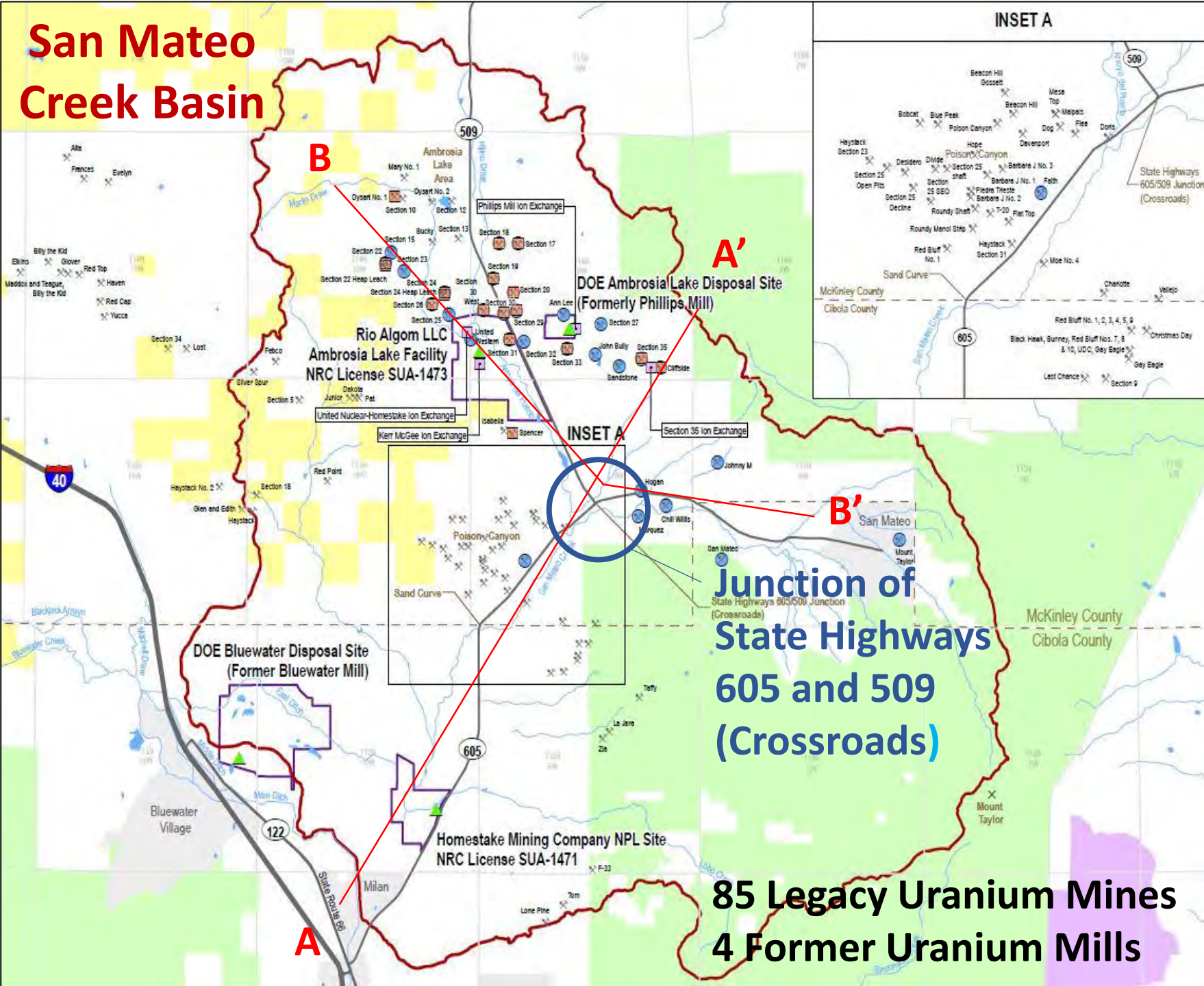
- Navajo
- Laguna Pueblo
- Acoma Pueblo
- Zuni Pueblo
- USFS

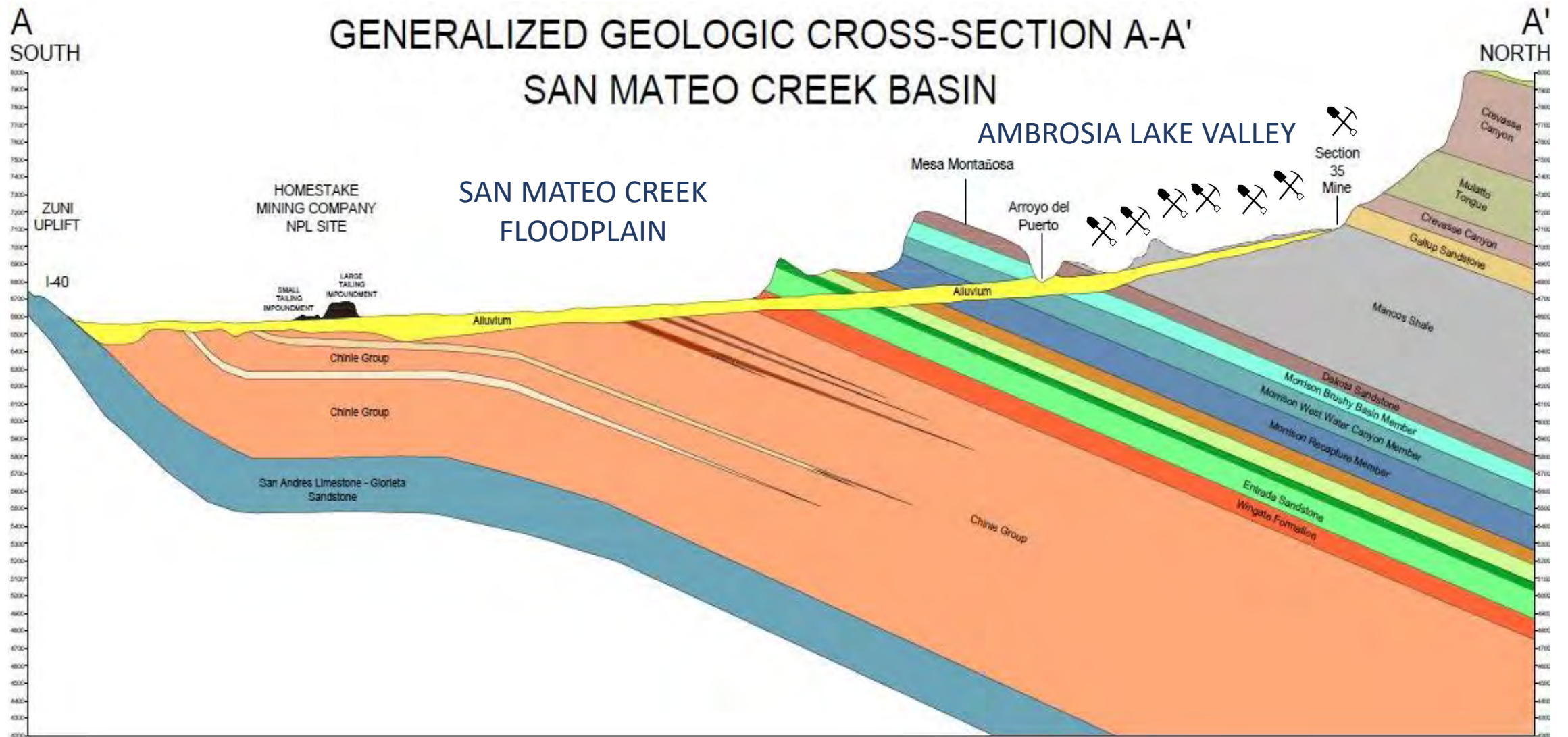
LOCATION MAP
GRANTS MINING DISTRICT



SITE MAP

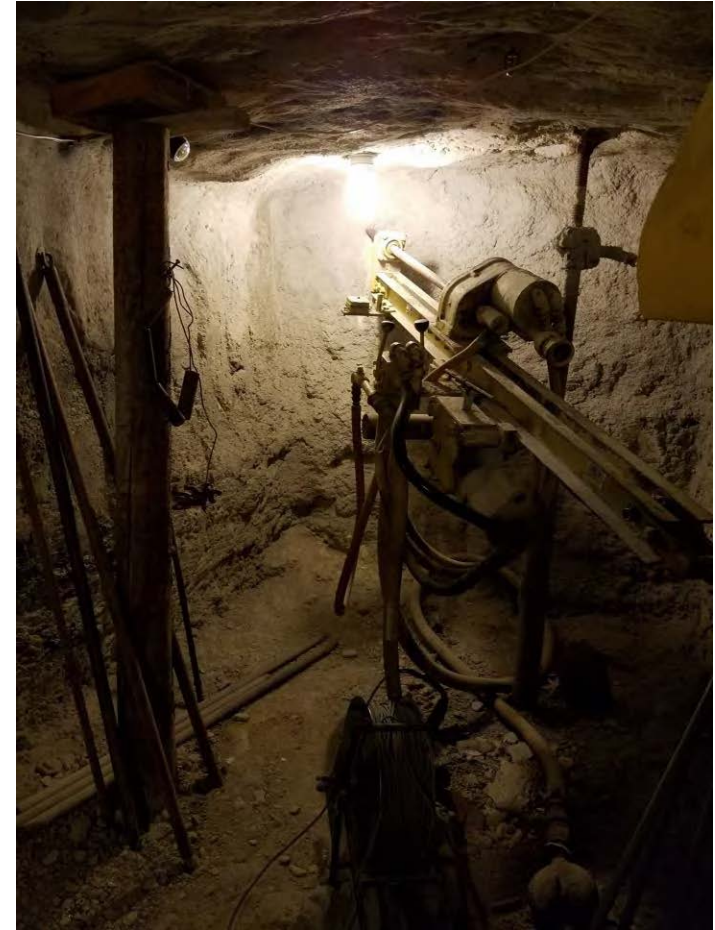
- Navajo
- Laguna Pueblo
- USFS
- Wet Mine
- Tronox Mine





LEGACY URANIUM WET MINE OPERATIONS

- UNDERGROUND MINE
- ORE-BEARING FORMATION SATURATED
- MINE WATER PUMPED TO SURFACE AND DISCHARGED
 - Began in 1958
 - Untreated Until Late 1970s
- BILLION OF GALLONS OF MINE WATER DISCHARGED TO SURFACE






30+ MINE WATER DISCHARGE OPERATIONS

[illegible]

FOR ILLUSTRATION ONLY

Legend

12.5 Billion Gallons Discharged

-  Wet Mine Shafts
-  Ore Body
-  Mine Discharge Water as surface flow

Legend

12.5 Billion Gallons Discharged

 **Wet Mine Shafts**



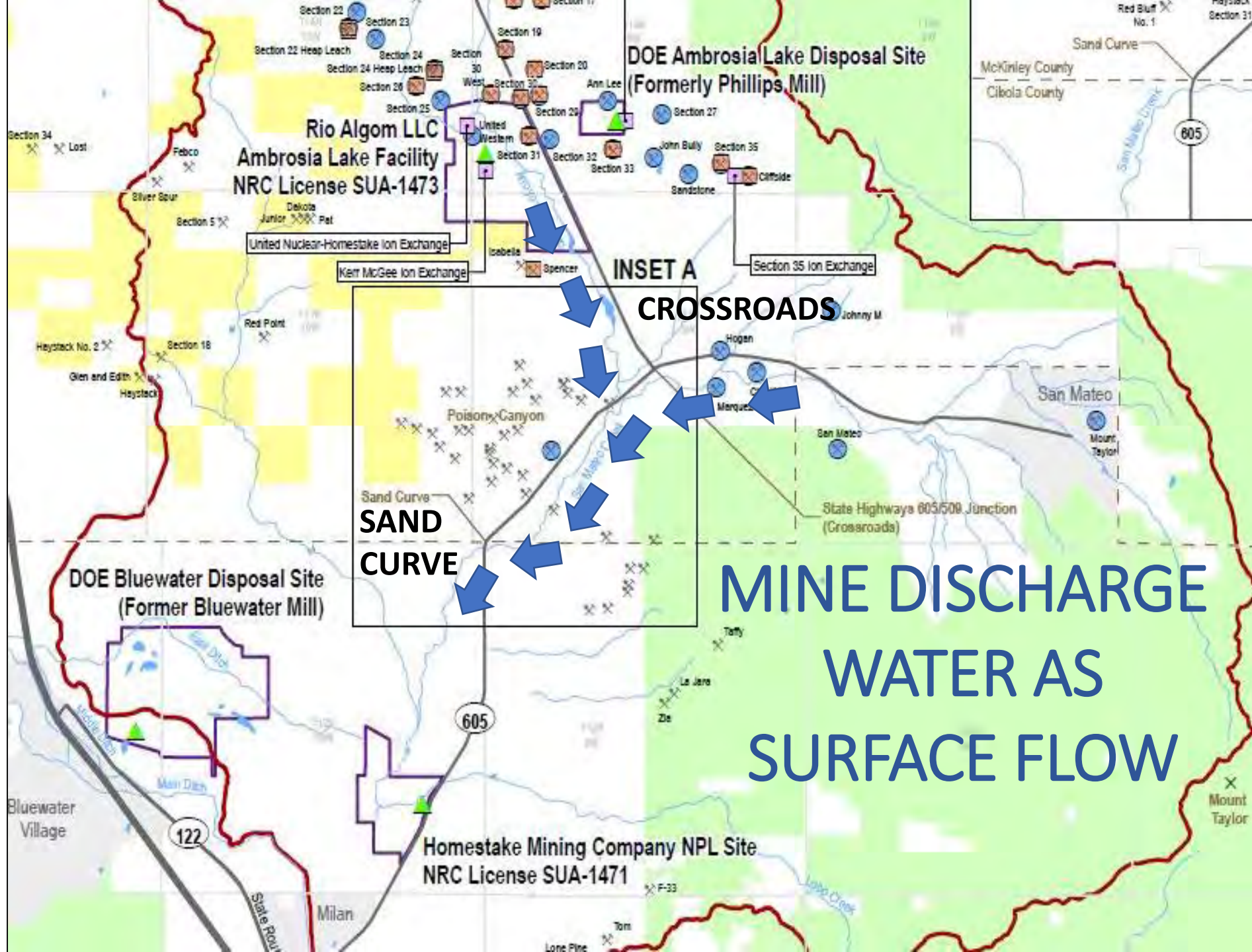
Ore Body

 **Mine Discharge Water as surface flow**

CROSSROADS

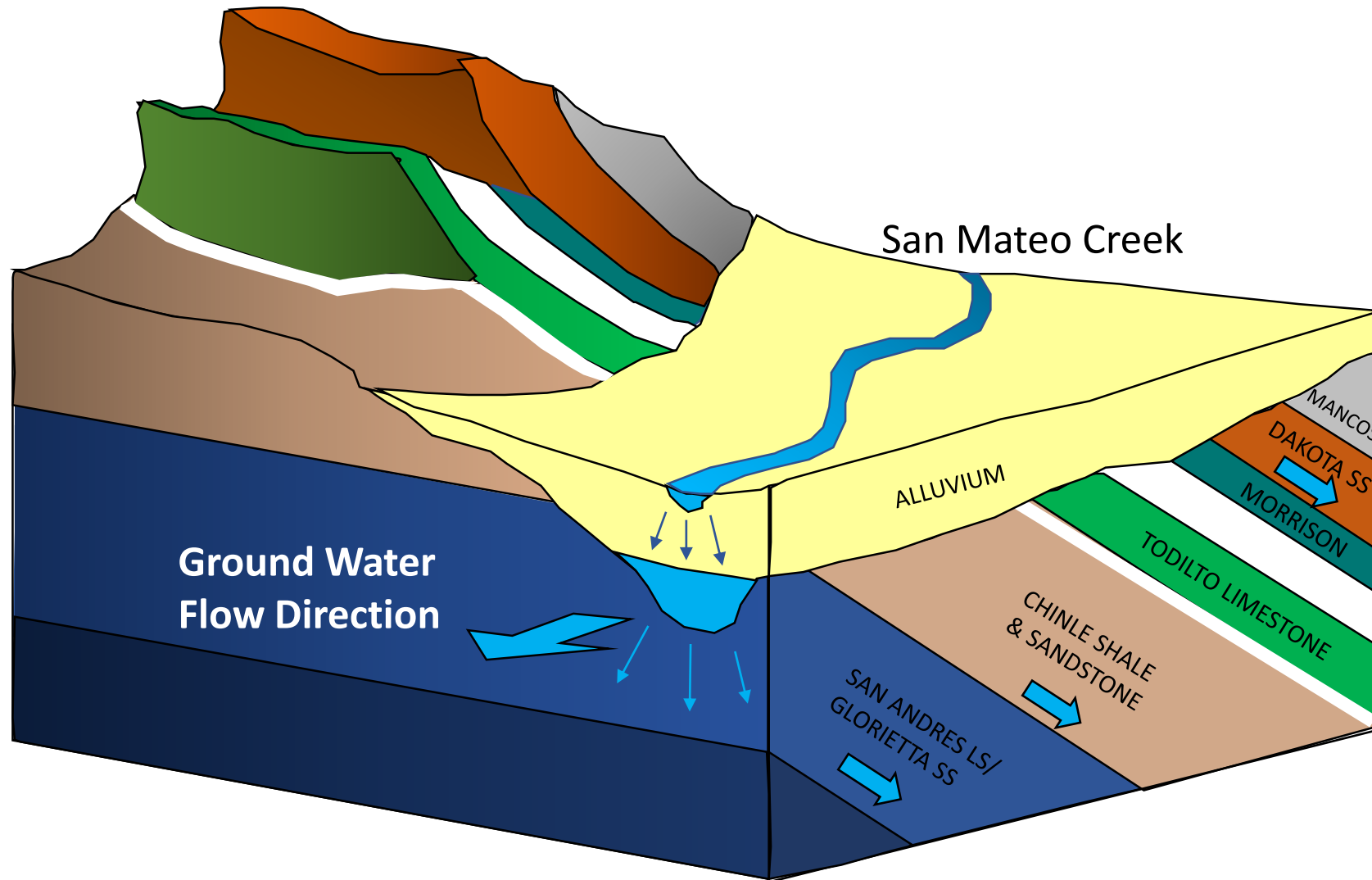
Draft – For Discussion Purposes Only

**SURFACE
WATER
FLOW
DIRECTION**




**MINE DISCHARGE
WATER AS
SURFACE FLOW**

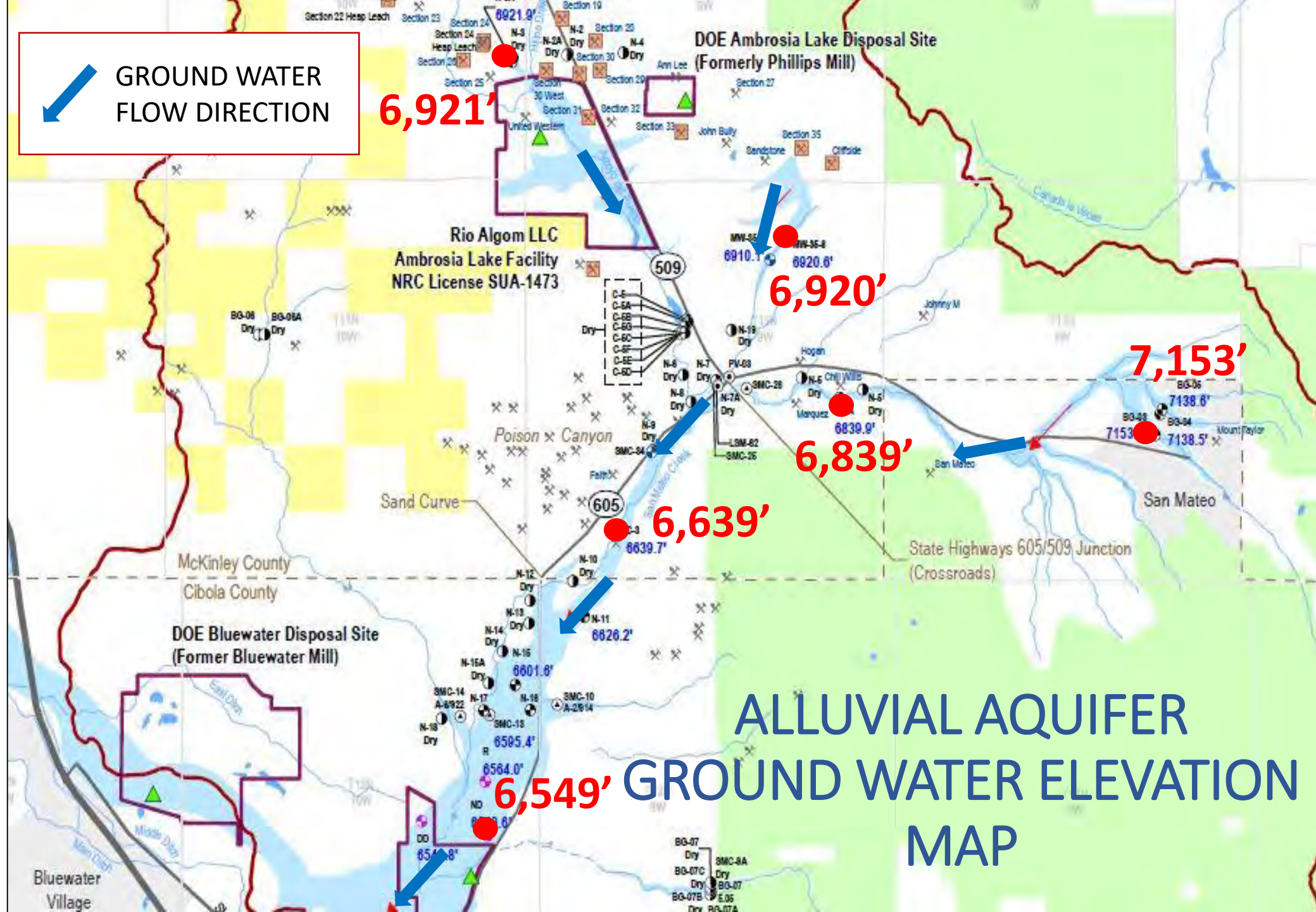
CONCEPTUAL SITE GROUND WATER MODEL



Draft – For Discussion Purposes Only
Not to Scale



GROUND WATER
FLOW DIRECTION



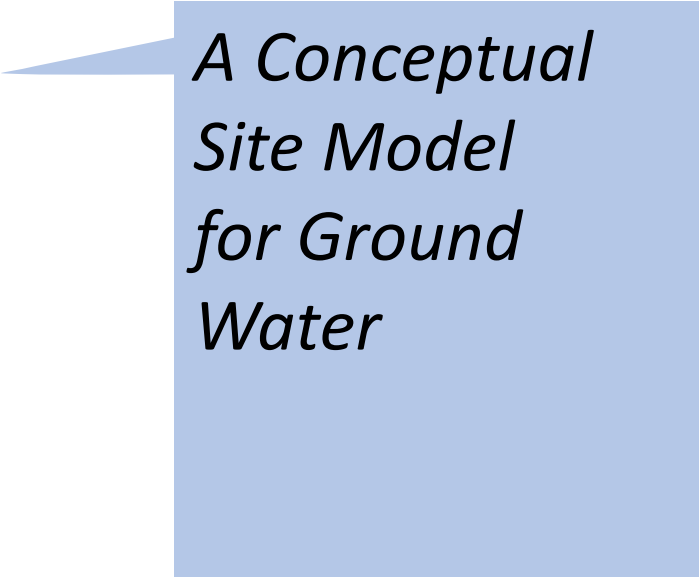
PURPOSE OF GROUND WATER STUDY

- ASSESS IMPACTS FROM MINING INDUSTRY ON GROUND WATER
 - MULTI-PHASED INVESTIGATION
 - Part of Grants Mining District 5-Year Plan
 - Scoping Began in 2012
 - Focus on **Mine Discharge Water (MDW) Impacts** ★
 - PHASE 1 – ALLUVIAL AQUIFER
 - 2012 – 2016
 - PHASE 2 – ALLUVIAL AND BEDROCK AQUIFERS
 - 2015 – 2018



PHASE 2 REPORT OVERVIEW

- PART A – Hydrological, Water Quality, and Geochemistry Analysis
- PART B – Comparison of Ground Water Data to Federal/State Standards
- PART C – Review of Former Mills and Ground Water Corrective Action



*A Conceptual
Site Model
for Ground
Water*

PART A – A DIFFERENT APPROACH FOR ASSESSMENT OF MINING IMPACTS

- FOCUS ON MINE DISCHARGE WATER RECHARGE
- MULTIPLE LINES OF EVIDENCE
 - Forensic Fingerprinting

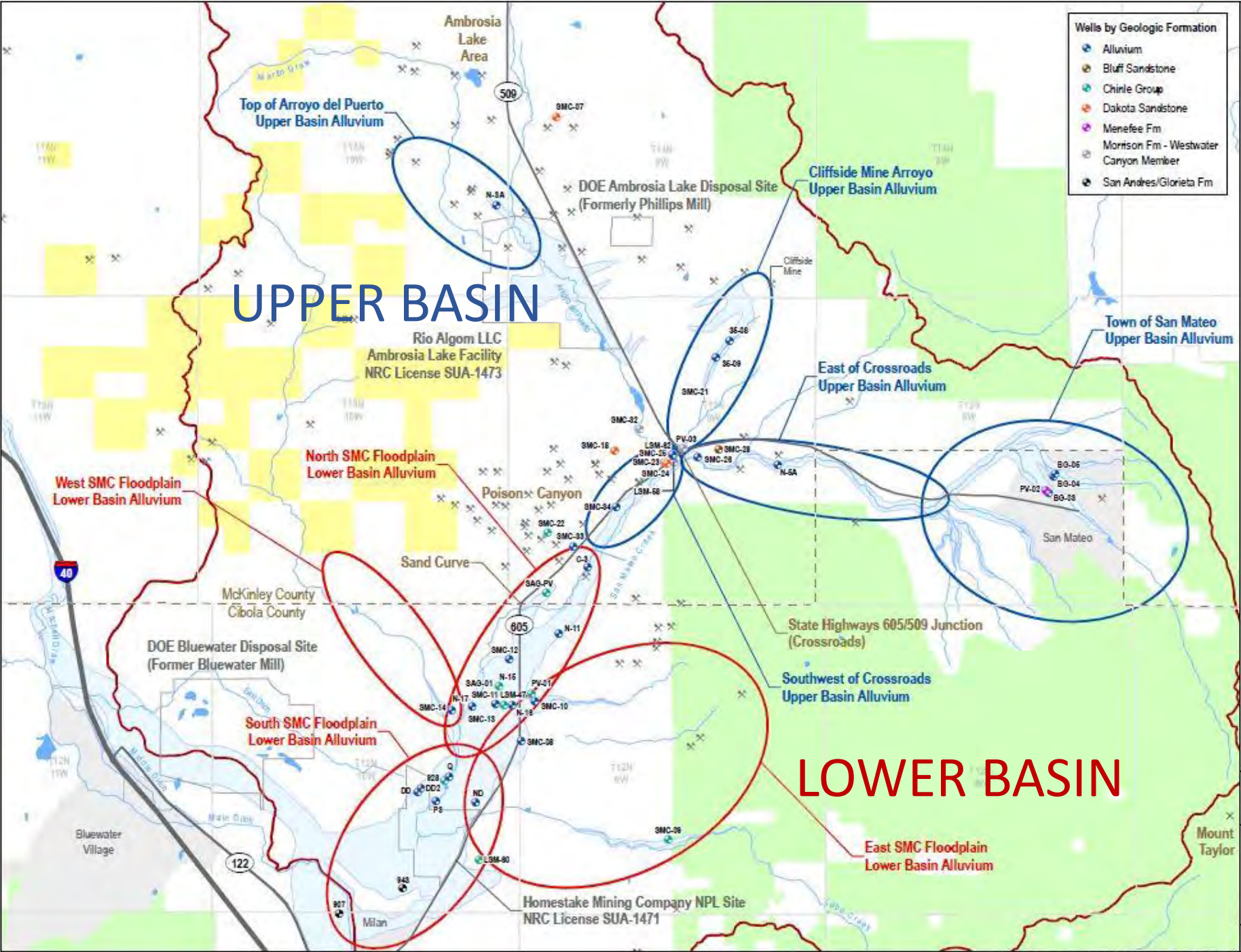


- DID NOT USE BACKGROUND APPROACH!

Private Domestic Wells
 Private Livestock Wells
 Industry Monitoring Wells
 State Monitoring Wells
 EPA Monitoring Wells
 EPA Borings
 DOE Monitoring Wells

- Private Domestic Wells
- Private Livestock Wells
- Industry Monitoring Wells
- State Monitoring Wells
- EPA Monitoring Wells
- EPA Borings
- DOE Monitoring Wells

WELLS
AND
GEOGRAPHICAL
AREAS
DEFINE
GEOCHEMICAL
EVALUATION



SUMMARY OF FINDINGS – PART A

- HYDRAULIC IMPACT

- Dramatic Hydraulic Response to Alluvial and Dakota Sandstone Aquifers

- WATER QUALITY IMPACT

- Uranium, Selenium Plumes Advance into Lower SMC Floodplain

- GEOCHEMICAL EVIDENCE OF IMPACT

- Major Ion Chemistry – Chloride and Sulfate
 - Similar Water Types for **Mine Discharge Water** and Aquifers
 - Sulfur Isotope Ratios

HYDRAULIC IMPACT

GEOLOGIC CROSS-SECTION C-C' SAN MATEO CREEK BASIN

C'

NORTH

C

SOUTH

C'

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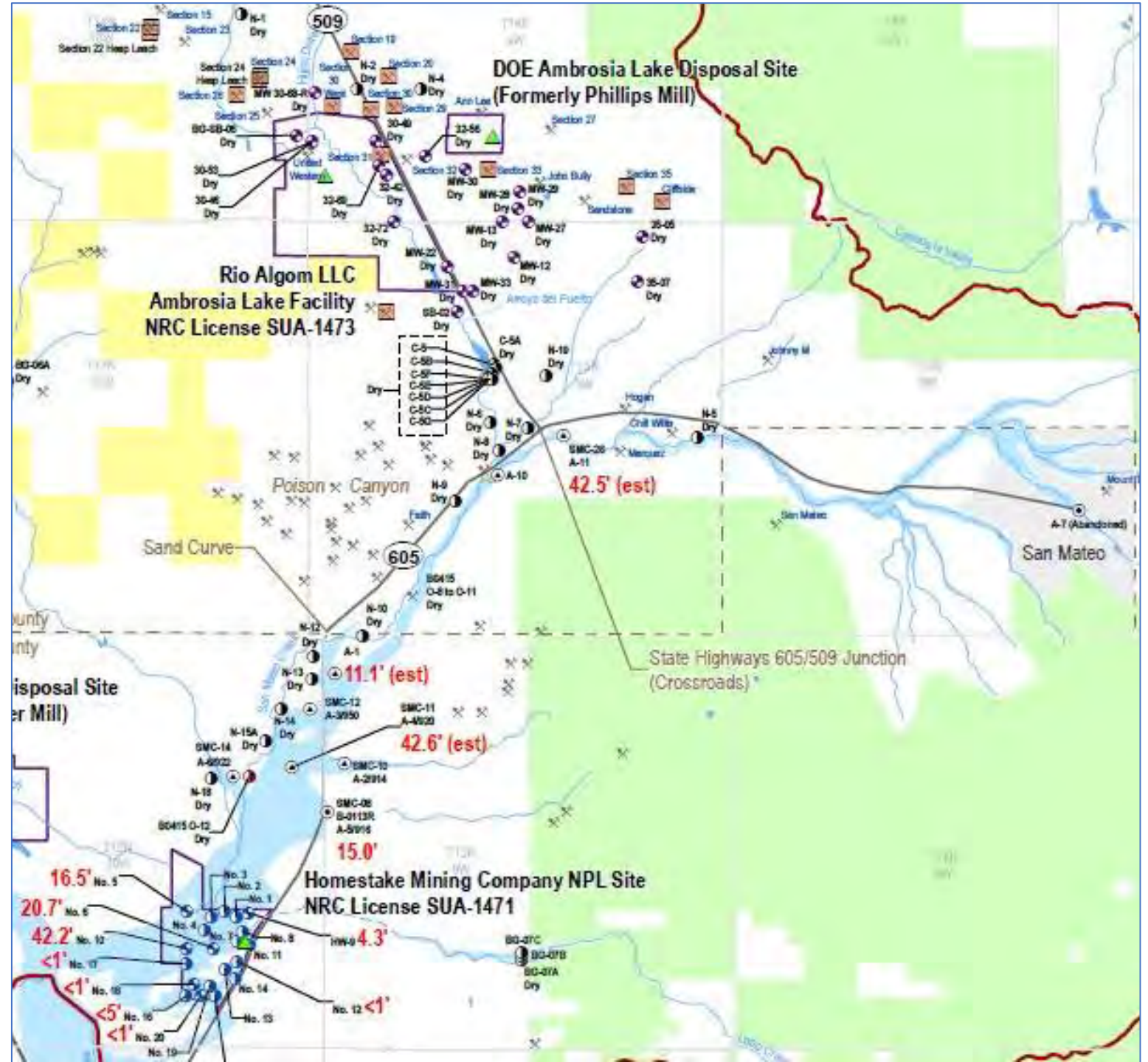
SOUTH

C'

NORTH

ALLUVIUM

1960



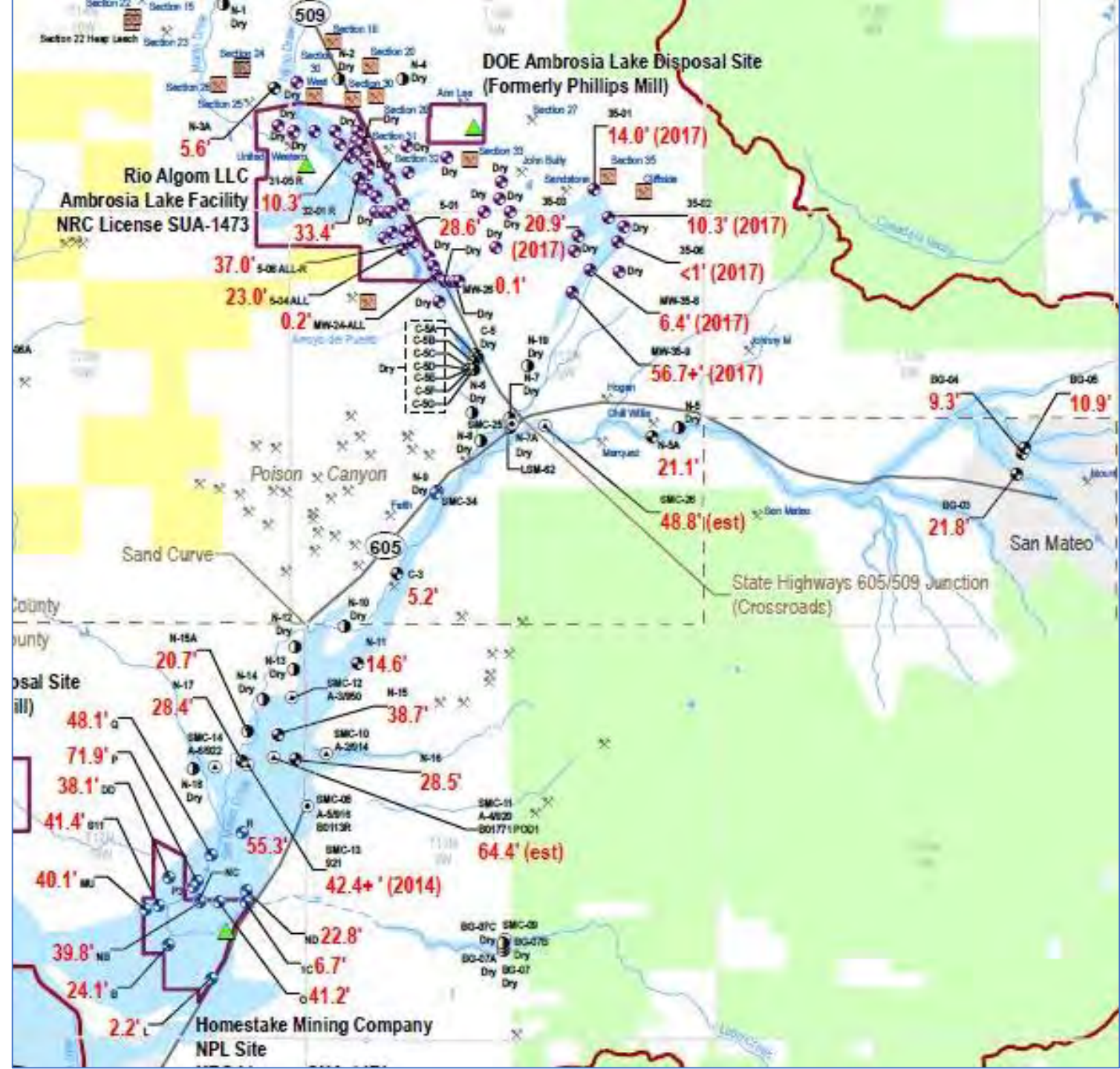
HYDRAULIC
IMPACT

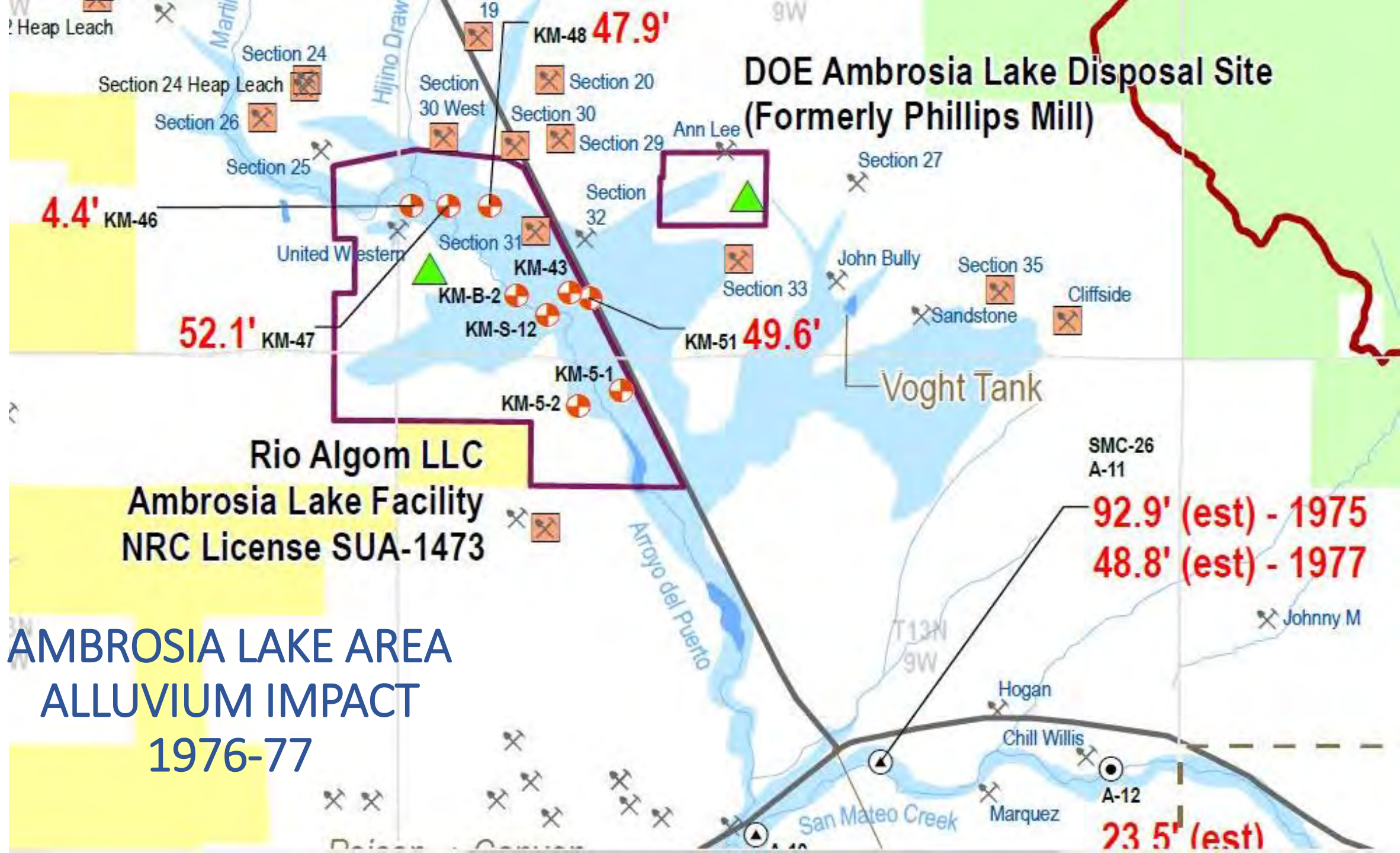
ALLUVIUM
1976-77



HYDRAULIC IMPACT

ALLUVIUM 2015

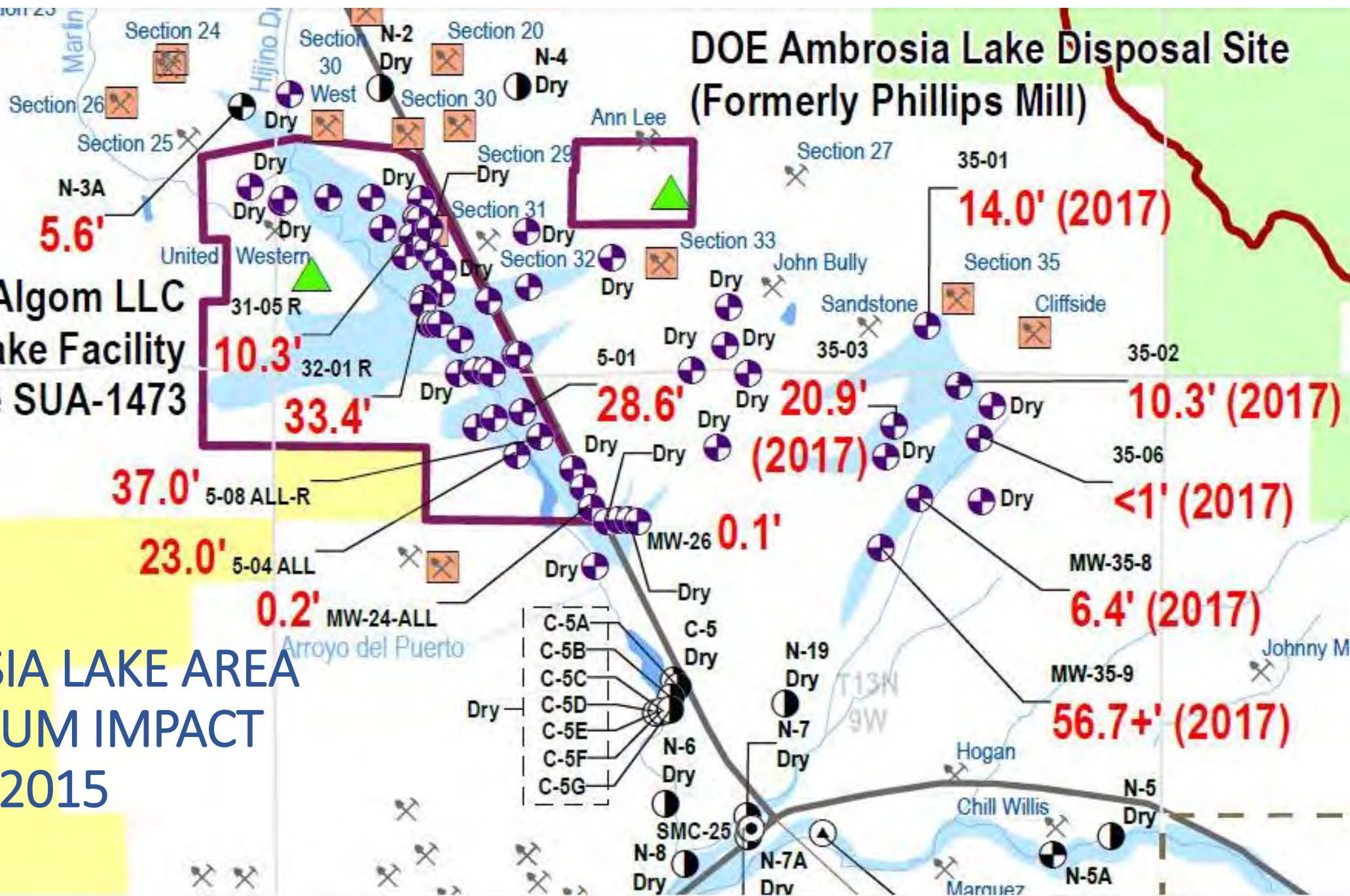




DOE Ambrosia Lake Disposal Site (Formerly Phillips Mill)

Rio Algom LLC
Ambrosia Lake Facility
NRC License SUA-1473

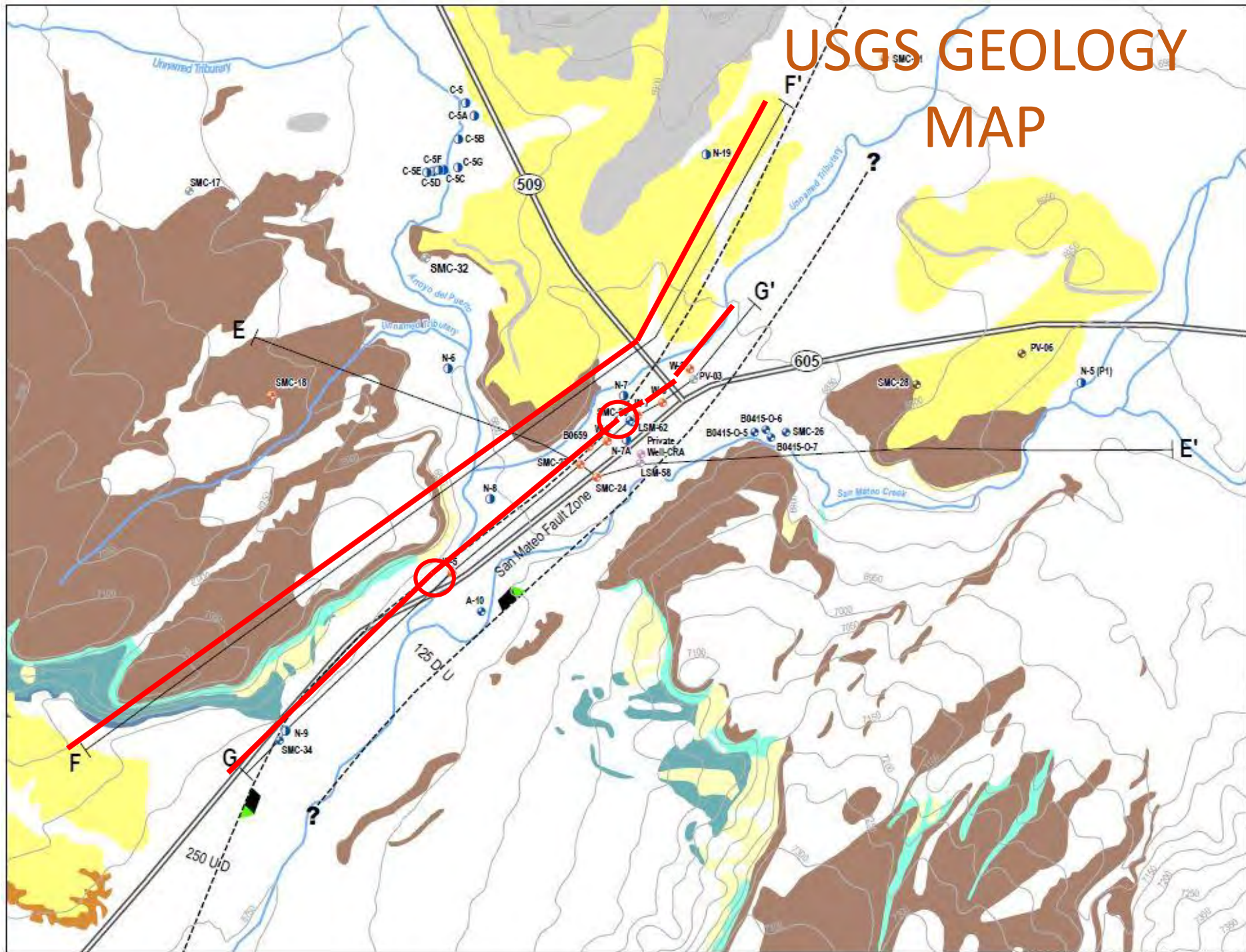
AMBROSIA LAKE AREA
ALLUVIUM IMPACT
2015



CROSSROADS AREA



Dramatic Water Level Change in Dakota Wells from 1957 to 1977-78

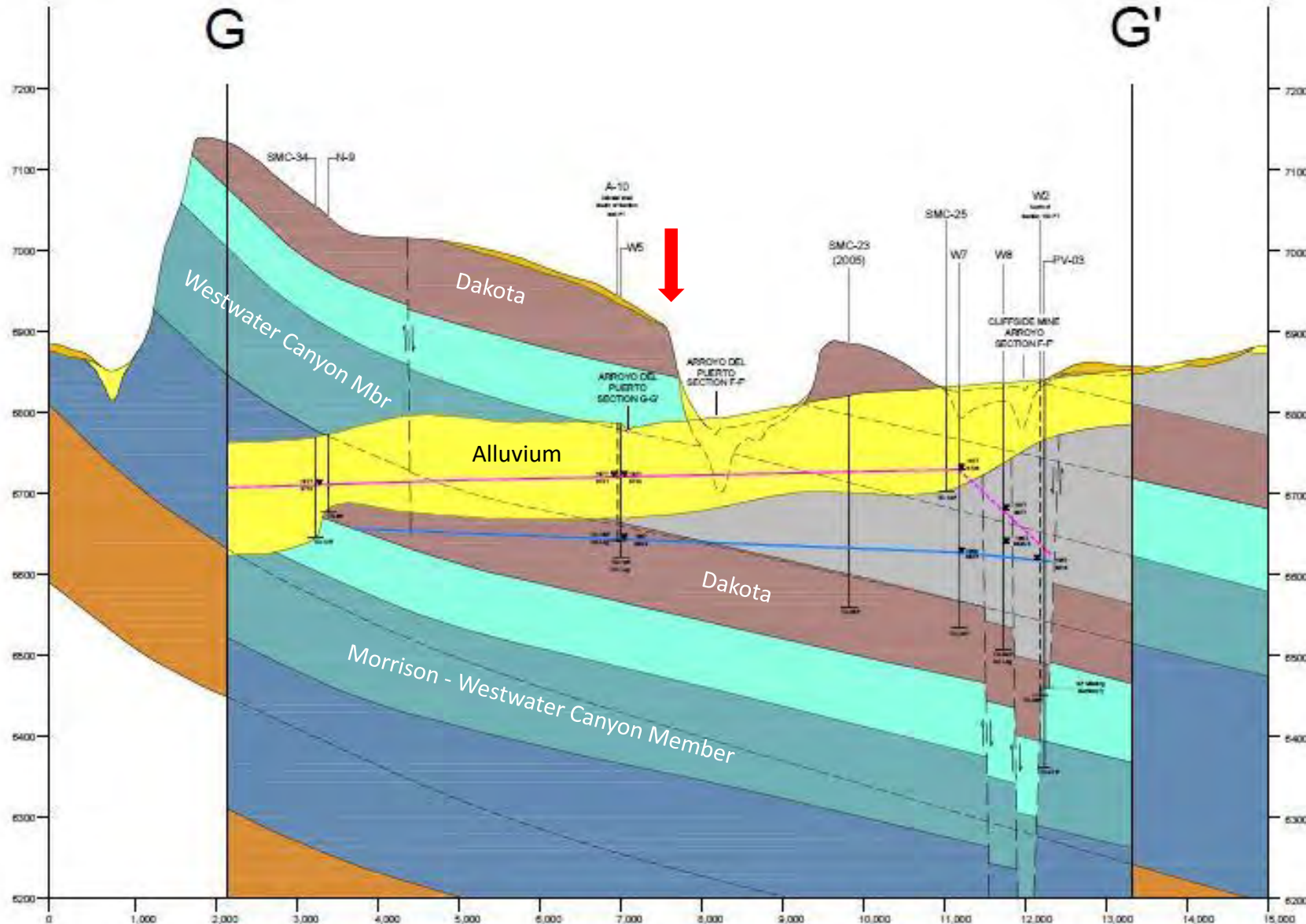


F
SW

HYDROGEOLOGIC CROSS SECTIONS

Crossroads Area

F'
NE



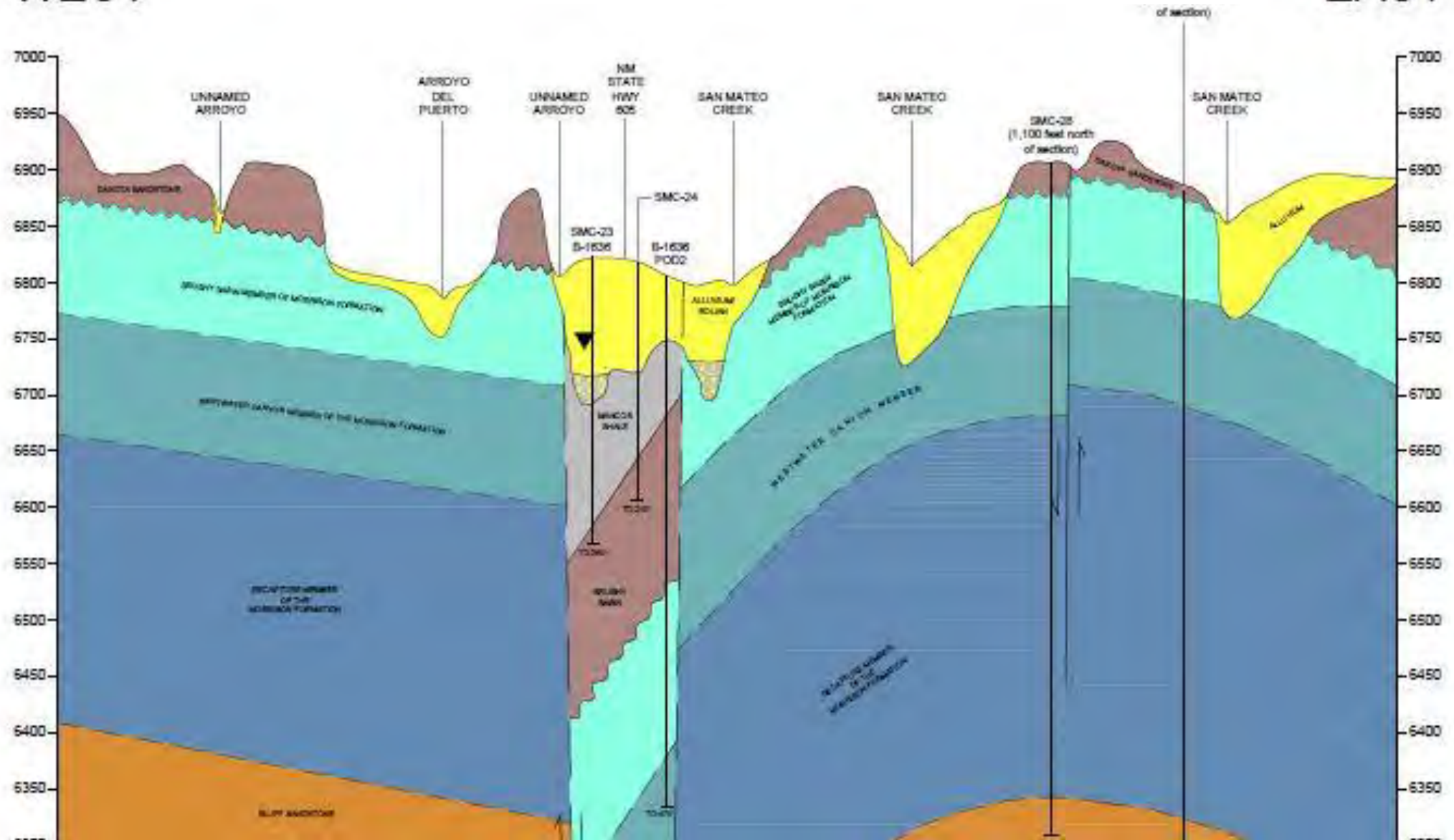
Dakota Sandstone - Crossroads

- 1957 Dakota Water Level
- 1977 Dakota Water Level

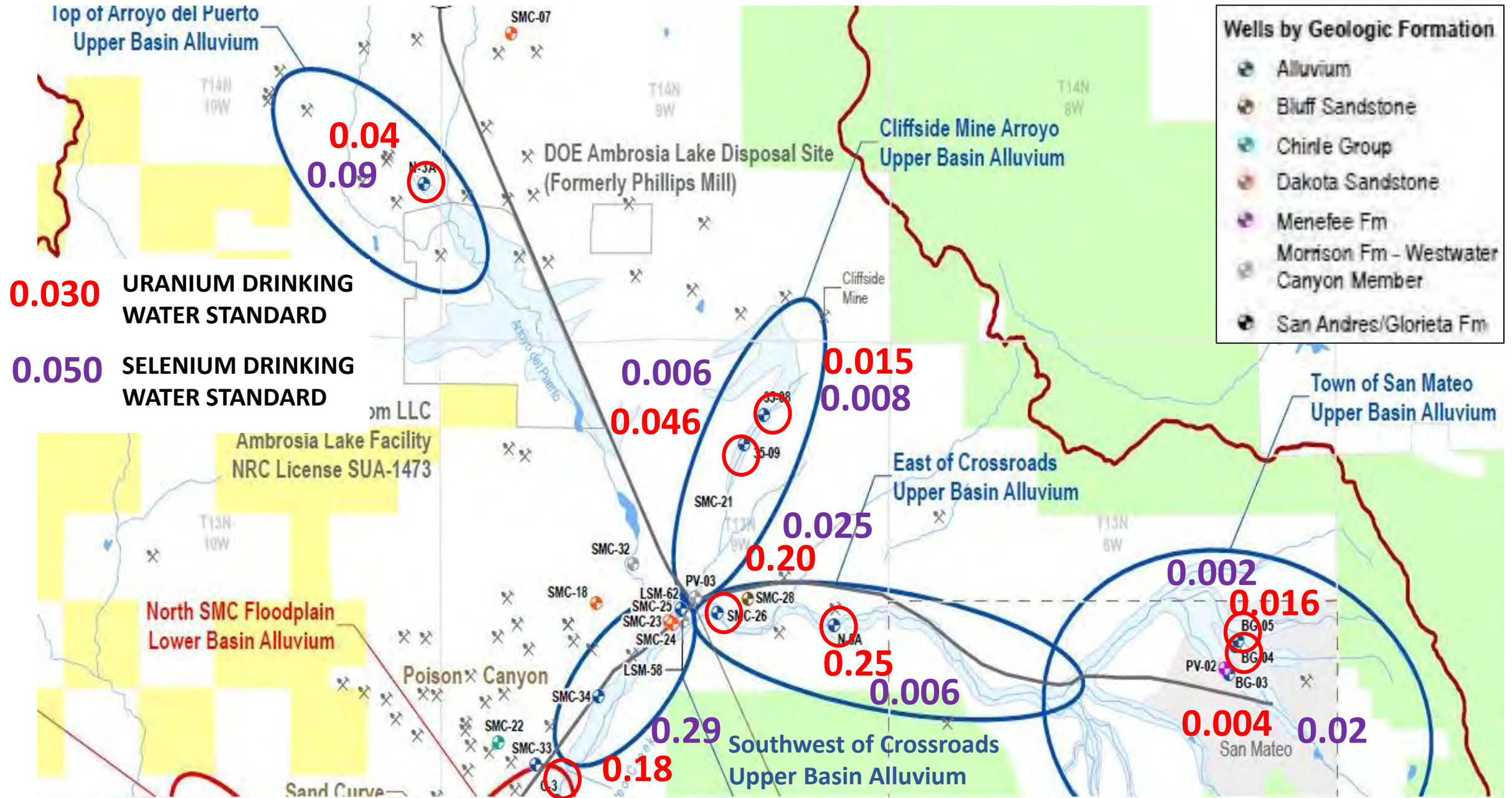
E
WEST

HYDROGEOLOGIC CROSS SECTION Crossroads Area

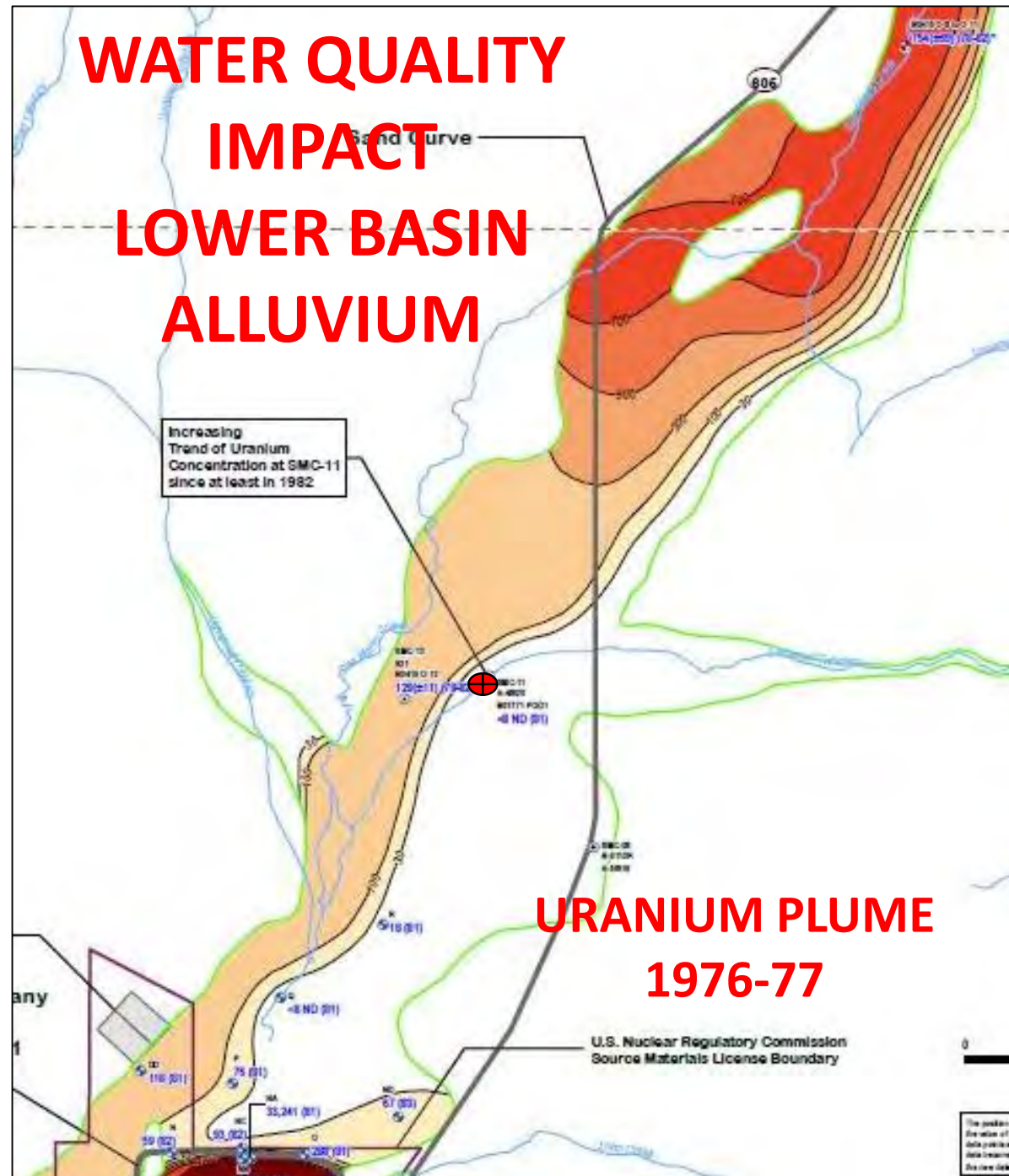
E'
EAST



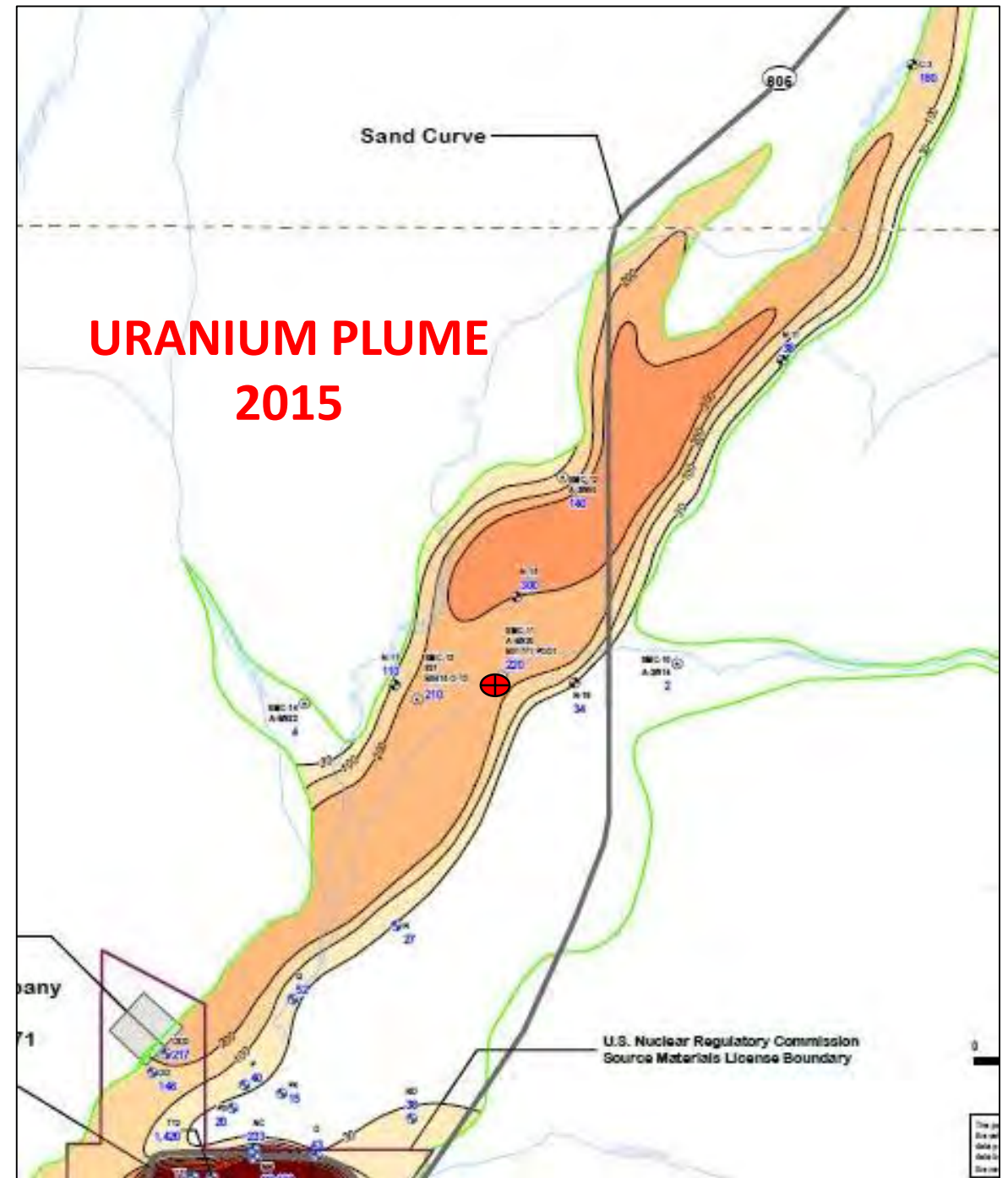
WATER QUALITY IMPACT – UPPER BASIN ALLUVIUM



WATER QUALITY IMPACT LOWER BASIN ALLUVIUM



URANIUM PLUME 2015



**WATER QUALITY
IMPACT
LOWER BASIN
ALLUVIUM**

**SELENIUM PLUME
1976-77**

U.S. Nuclear Regulatory Commission
Source Materials License Boundary

Sand Curve

Monitoring points and data values:

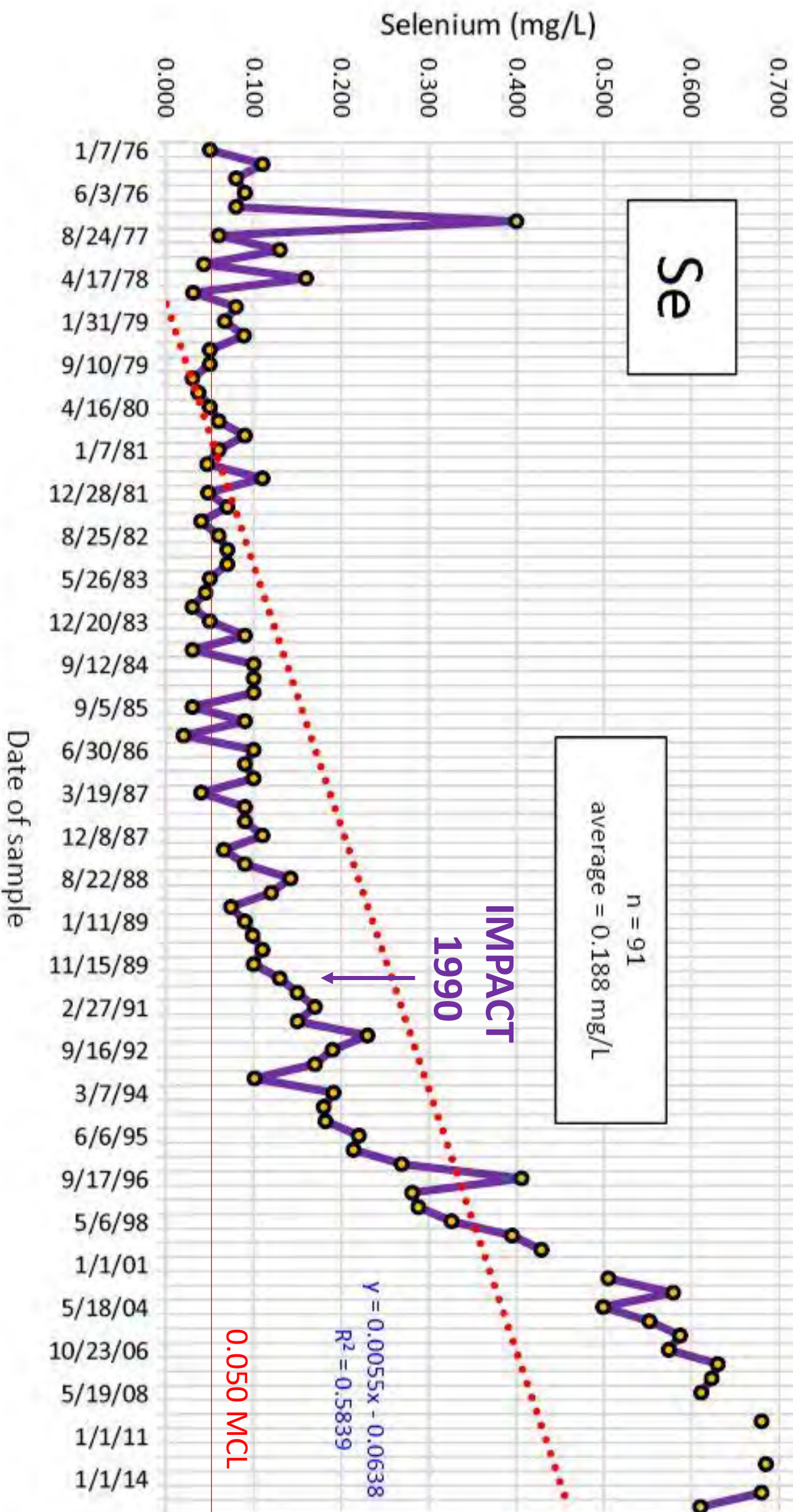
- SD415 C-4 to C-11: 80-102 (78-82)
- SD415 C-12: 273 (± 128) (78-82)
- SD415 C-13: 821
- SD415 C-14: 200 (81)
- SD415 C-15: 170 (81)
- SD415 C-16: 20 (81)
- SD415 C-17: 130 (82)
- SD415 C-18: 4,550 (81)
- SD415 C-19: 100 (81)
- SD415 C-20: 190 (81)
- SD415 C-21: 40 (83)
- SD415 C-22: 80 (82)
- SD415 C-23: 100 (81)
- SD415 C-24: 100 (81)
- SD415 C-25: 100 (81)
- SD415 C-26: 100 (81)
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- SD415 C-96: 100 (81)
- SD415 C-97: 100 (81)
- SD415 C-98: 100 (81)
- SD415 C-99: 100 (81)
- SD415 C-100: 100 (81)

The map displays the Selenium Plume in 2015, with the U.S. Nuclear Regulatory Commission Source Materials License Boundary indicated by a dashed line. Well R is marked with a black dot and labeled. The plume is shown as a shaded area, with a legend indicating the concentration ranges in micrograms per liter (µg/L):

- 100-200 µg/L (lightest shade)
- 200-300 µg/L (light shade)
- 300-400 µg/L (medium shade)
- 400-500 µg/L (dark shade)
- 500-600 µg/L (darkest shade)

Other features include the San Mateo Creek, the U.S. Nuclear Regulatory Commission Source Materials License Boundary, and the U.S. Nuclear Regulatory Commission Source Materials License Boundary. The map also shows the location of Well R and the U.S. Nuclear Regulatory Commission Source Materials License Boundary.

WELL R



KEY GEOCHEMICAL ANALYSES

- MAJOR ION CHEMISTRY

- Chloride
- Sulfate

- TRILINEAR DIAGRAMS

- Classification of Major Ion Water Types by Graphical Plots
- Comparison of MDW to Alluvium and Bedrock Water Types

- MINE DISCHARGE WATER INDICATOR PARAMETERS

- Total Dissolved Solids
- Selenium and Uranium
- Sulfur Isotope Ratio $^{34}\text{S}/^{32}\text{S}$ ($\delta^{34}\text{S}$) – Fingerprint Source of Sulfate in GW
- Uranium Activity Ratio

Upper and Lower Basin Bedrock Water Major Anion Concentration

2500

Concentration (mg/L)

0

■ Nitrate + nitrite As N □ Chloride ■ Bicarbonate ■ Sulfate

Bedrock, Upper

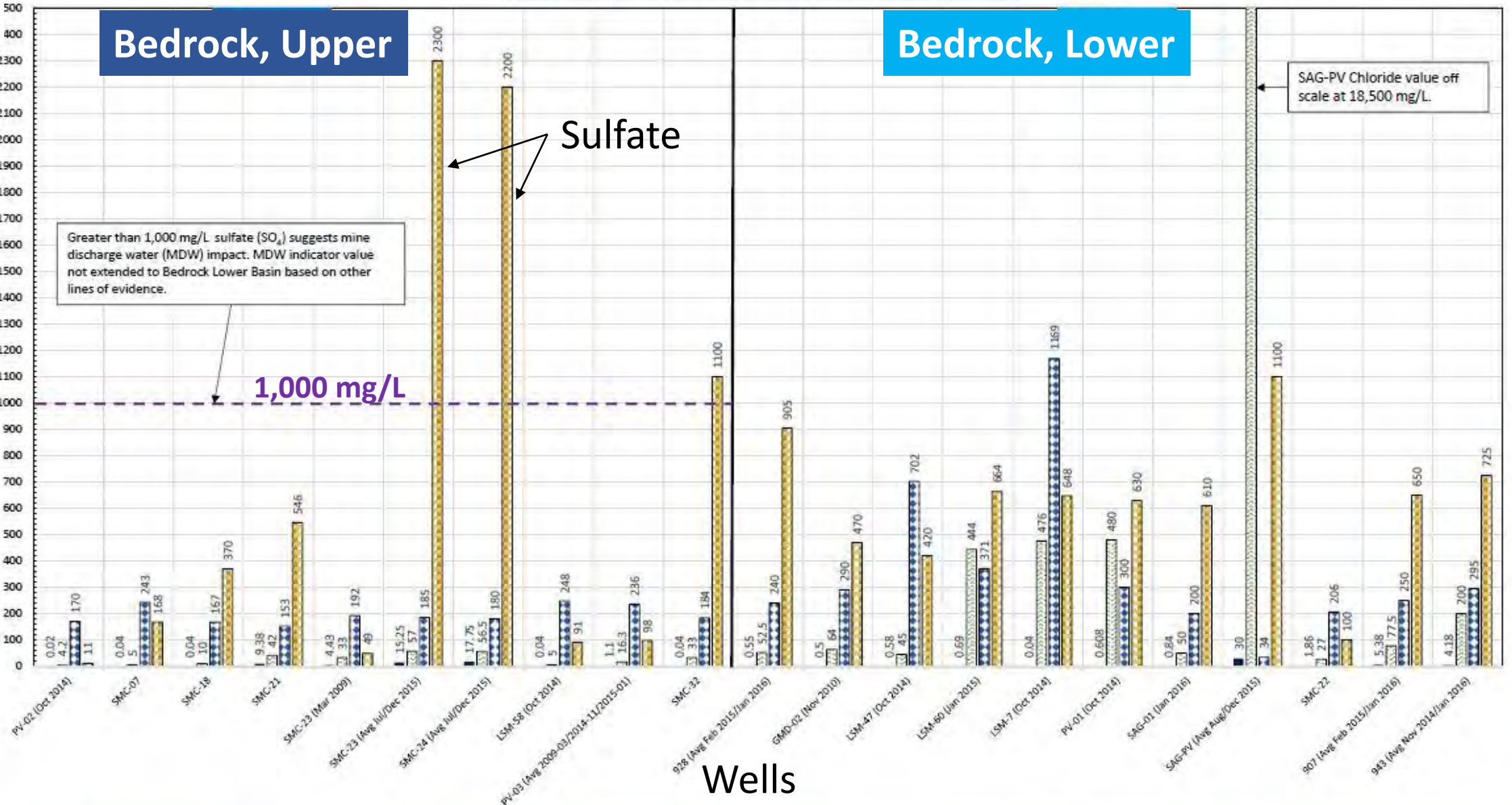
Bedrock, Lower

Sulfate

Greater than 1,000 mg/L sulfate (SO_4) suggests mine discharge water (MDW) impact. MDW indicator value not extended to Bedrock Lower Basin based on other lines of evidence.

1,000 mg/L

SAG-PV Chloride value off scale at 18,500 mg/L.



Wells

Menefee Fm

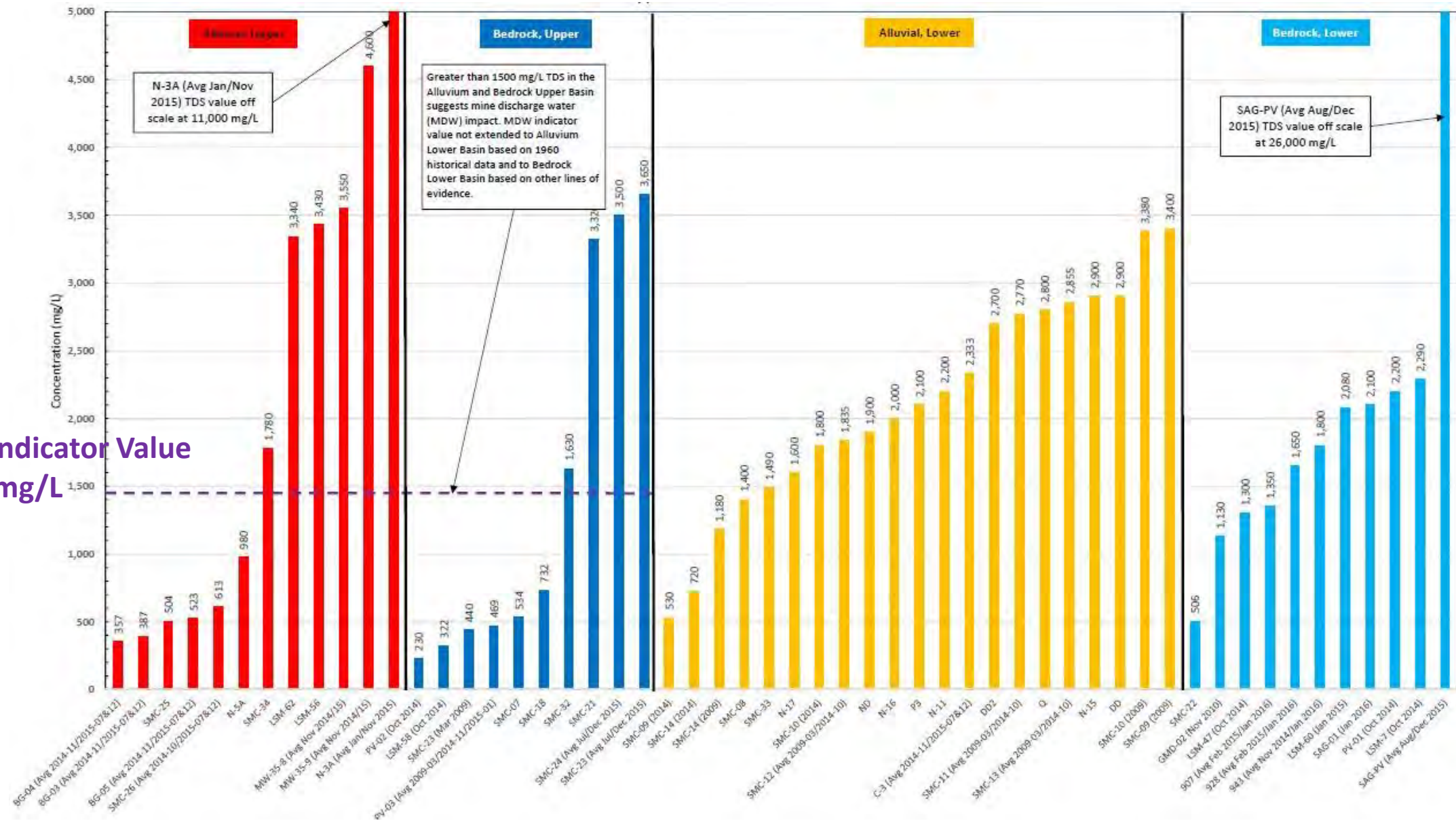
Dakota Sandstone

WCM

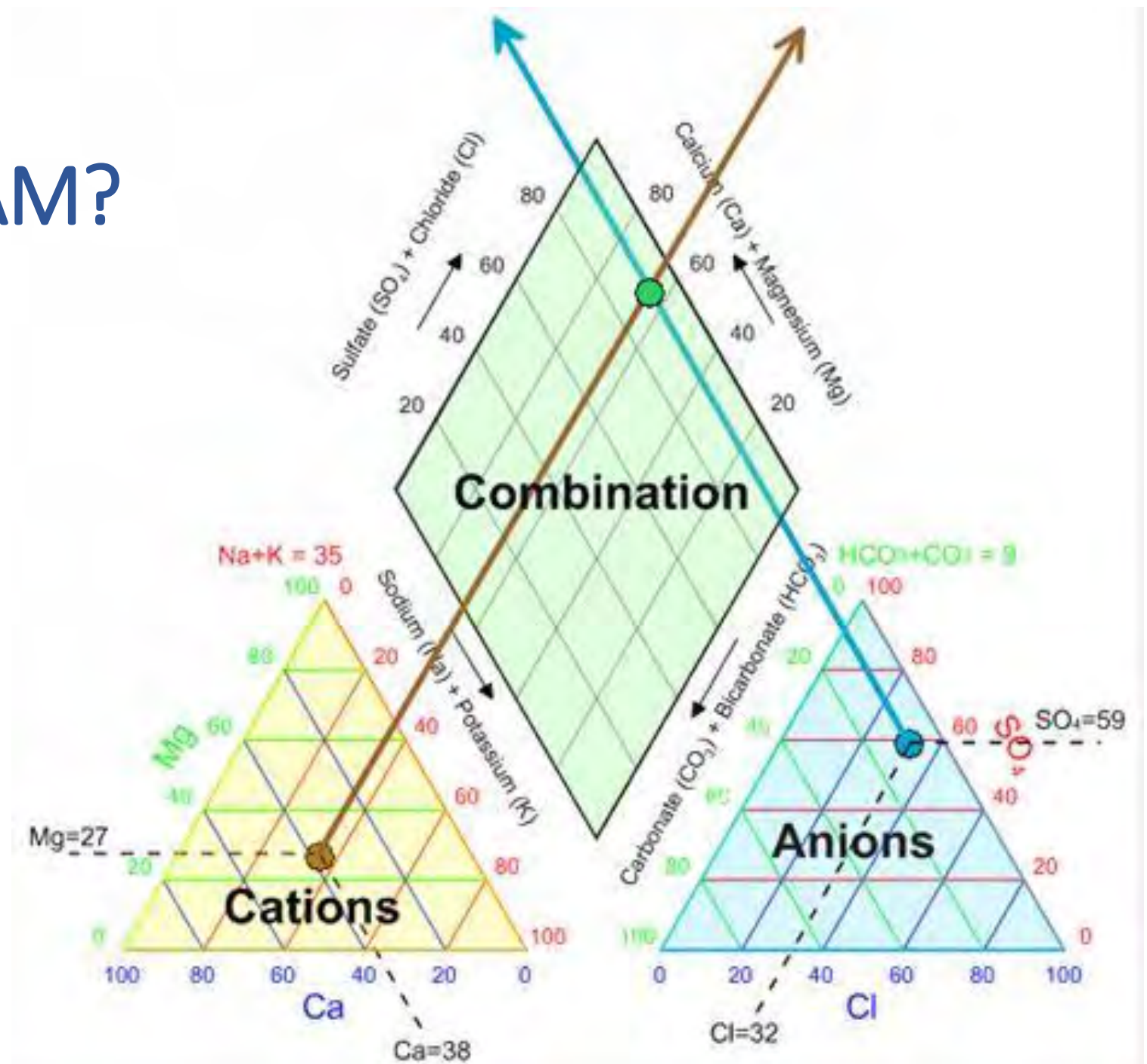
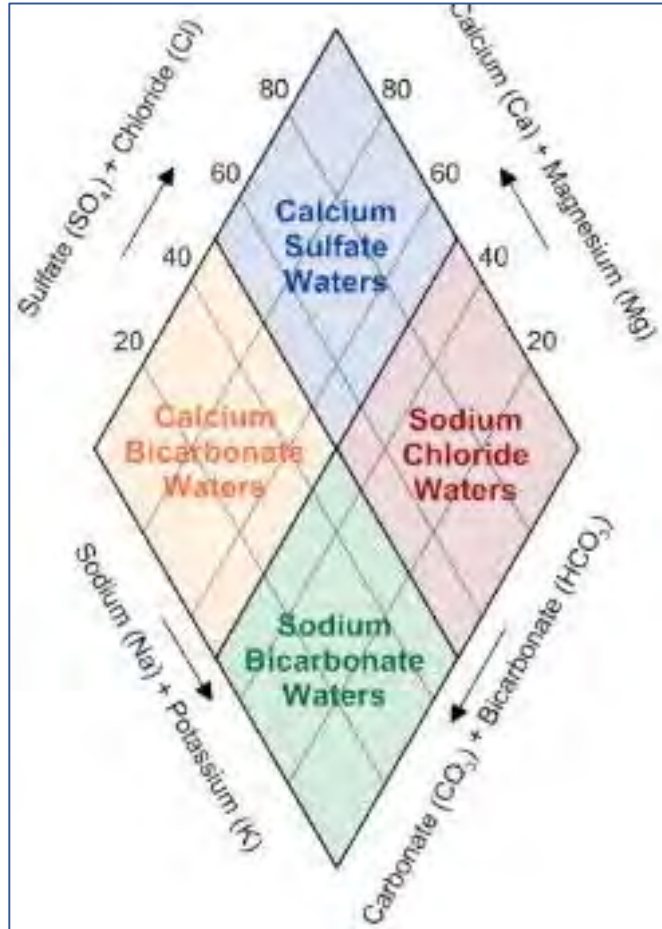
Chinle Group

SAG

TDS CONCENTRATIONS BY GEOGRAPHIC AREA



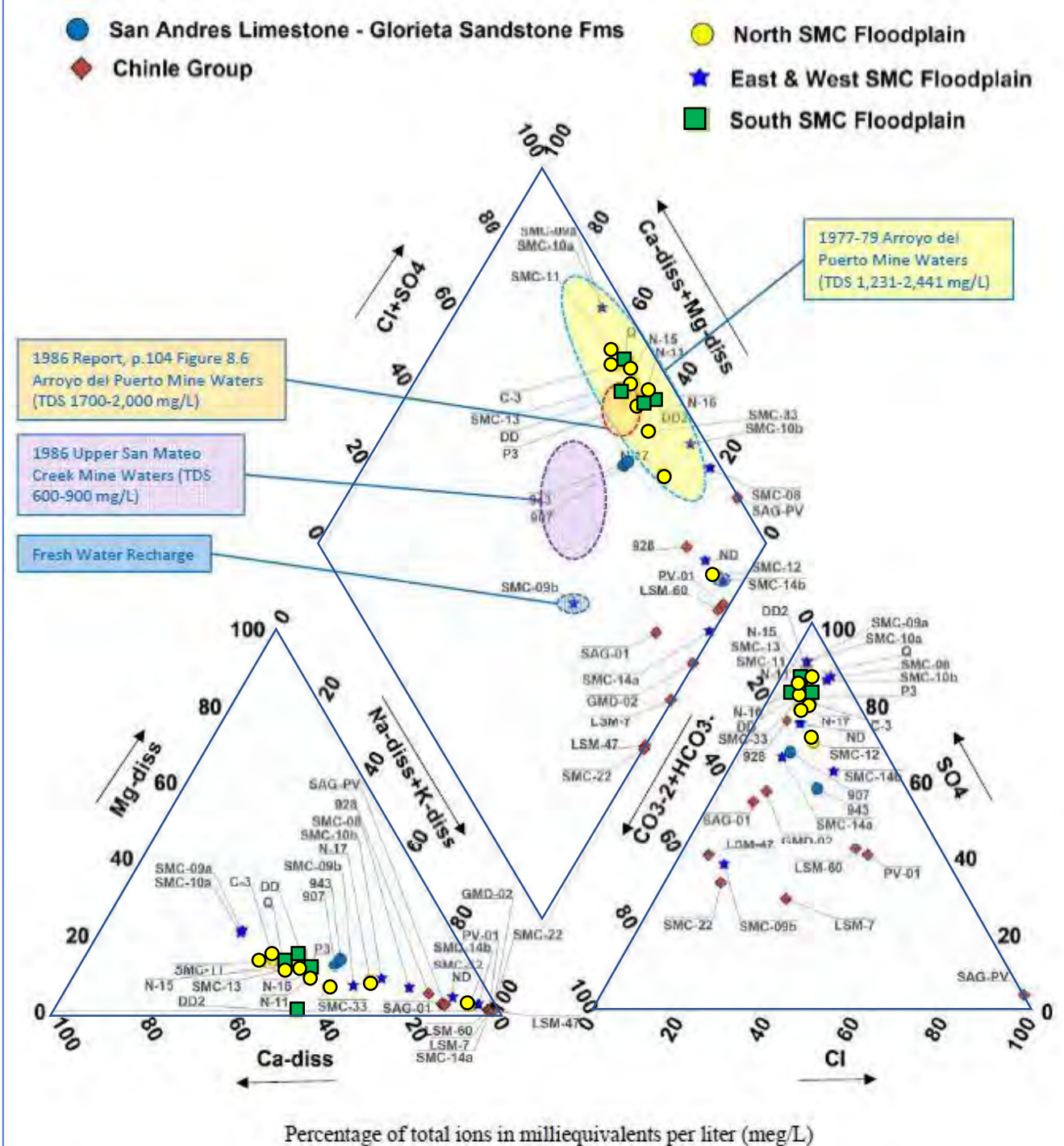
WHAT IS A TRILINEAR DIAGRAM?



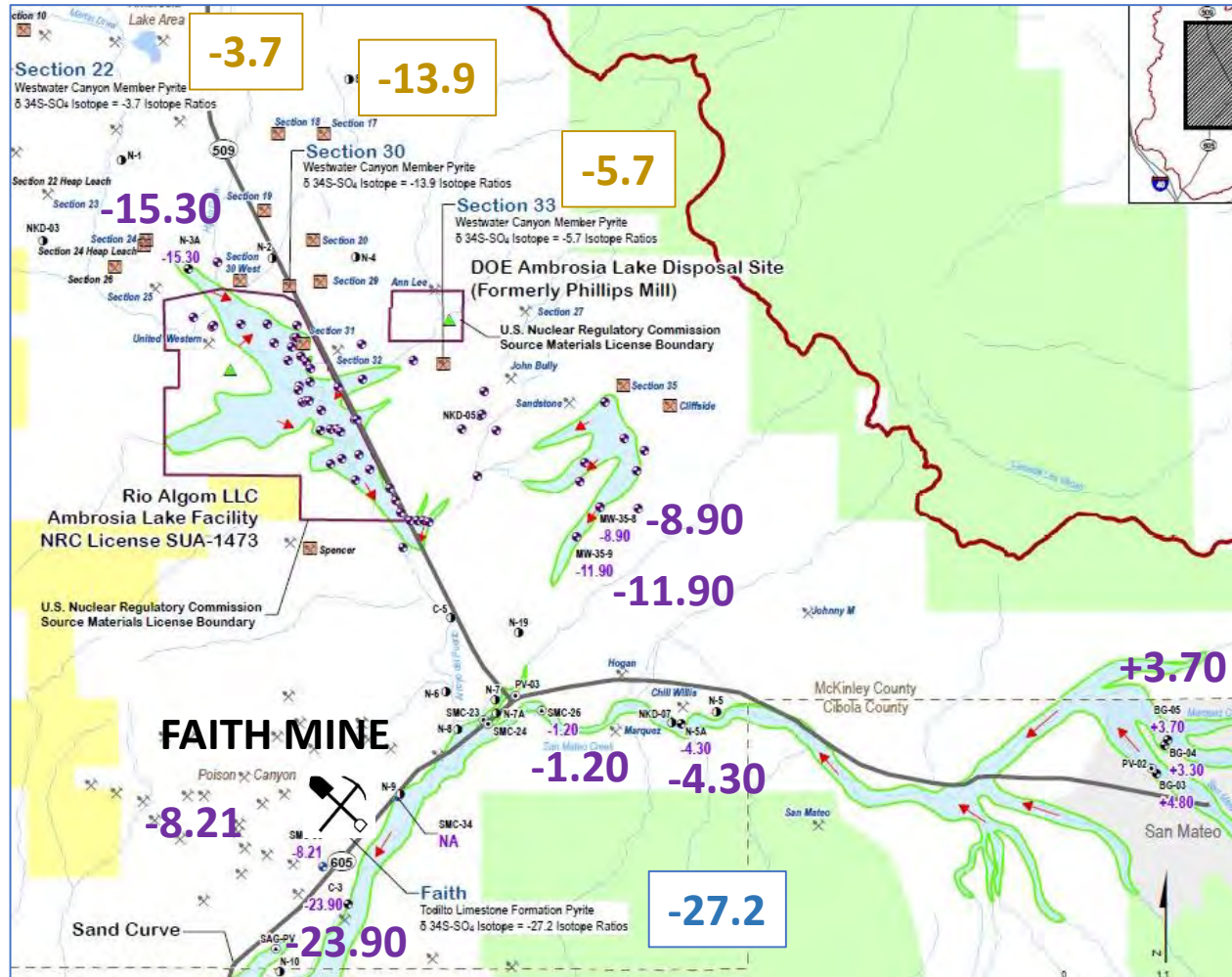
TRILINEAR DIAGRAM

LOWER BASIN

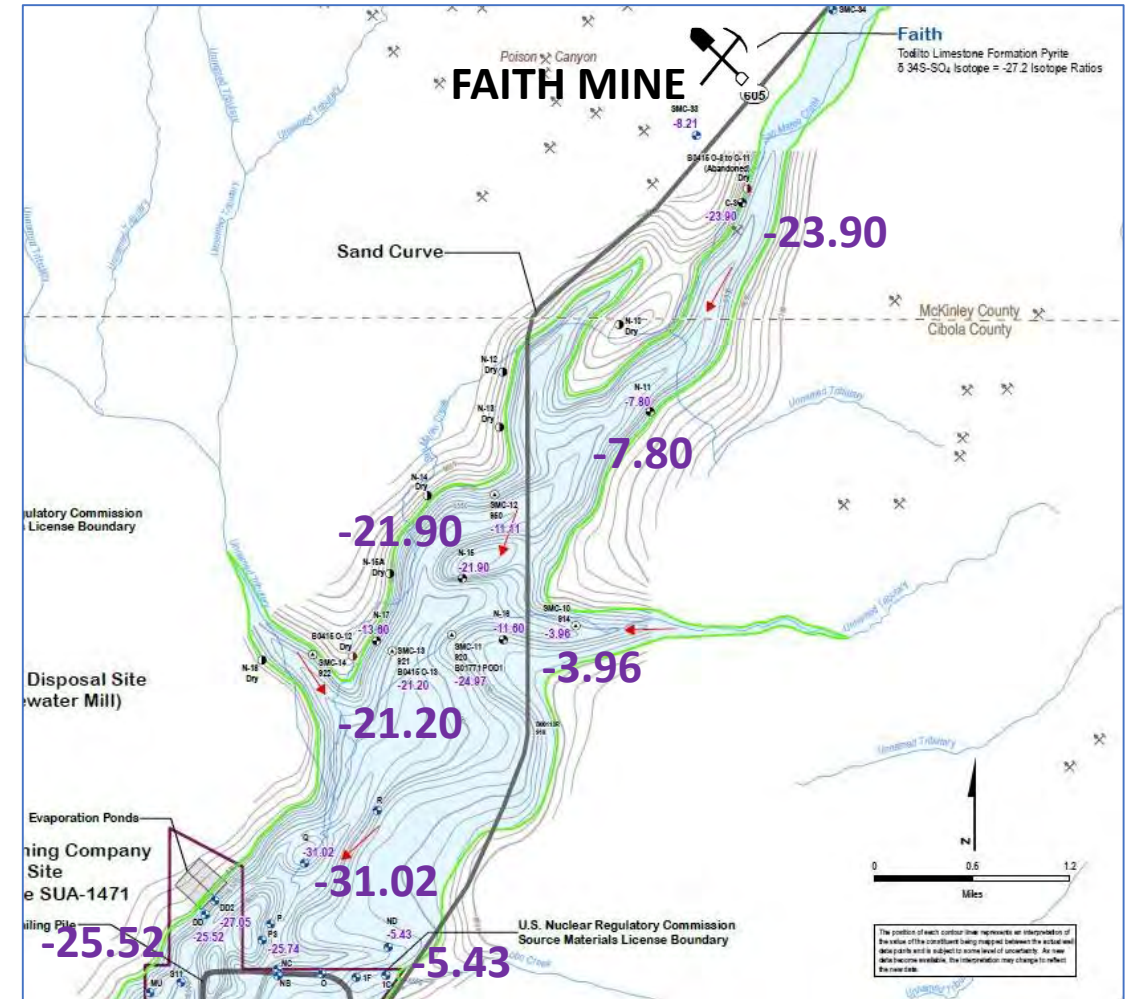
*Comparison of
Alluvium and Bedrock
water types
to
Historic Mine Effluent Discharge
water types of 1970s-1980s*



SULFUR ISOTOPE RATIO - A UNIQUE NEGATIVE FINGERPRINT FOR URANIUM ORE PYRITE







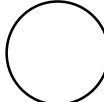
UPPER BASIN

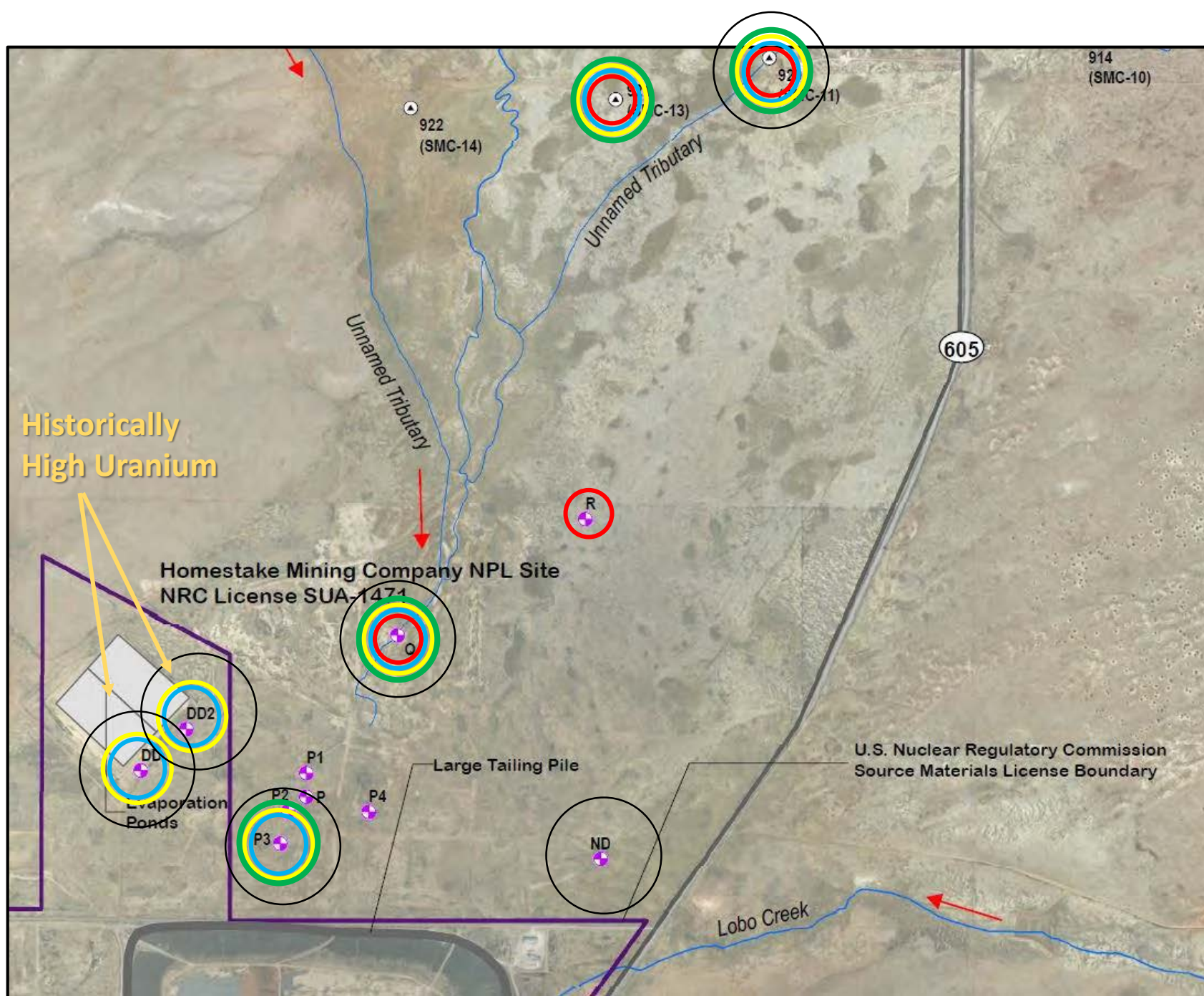


LOWER BASIN

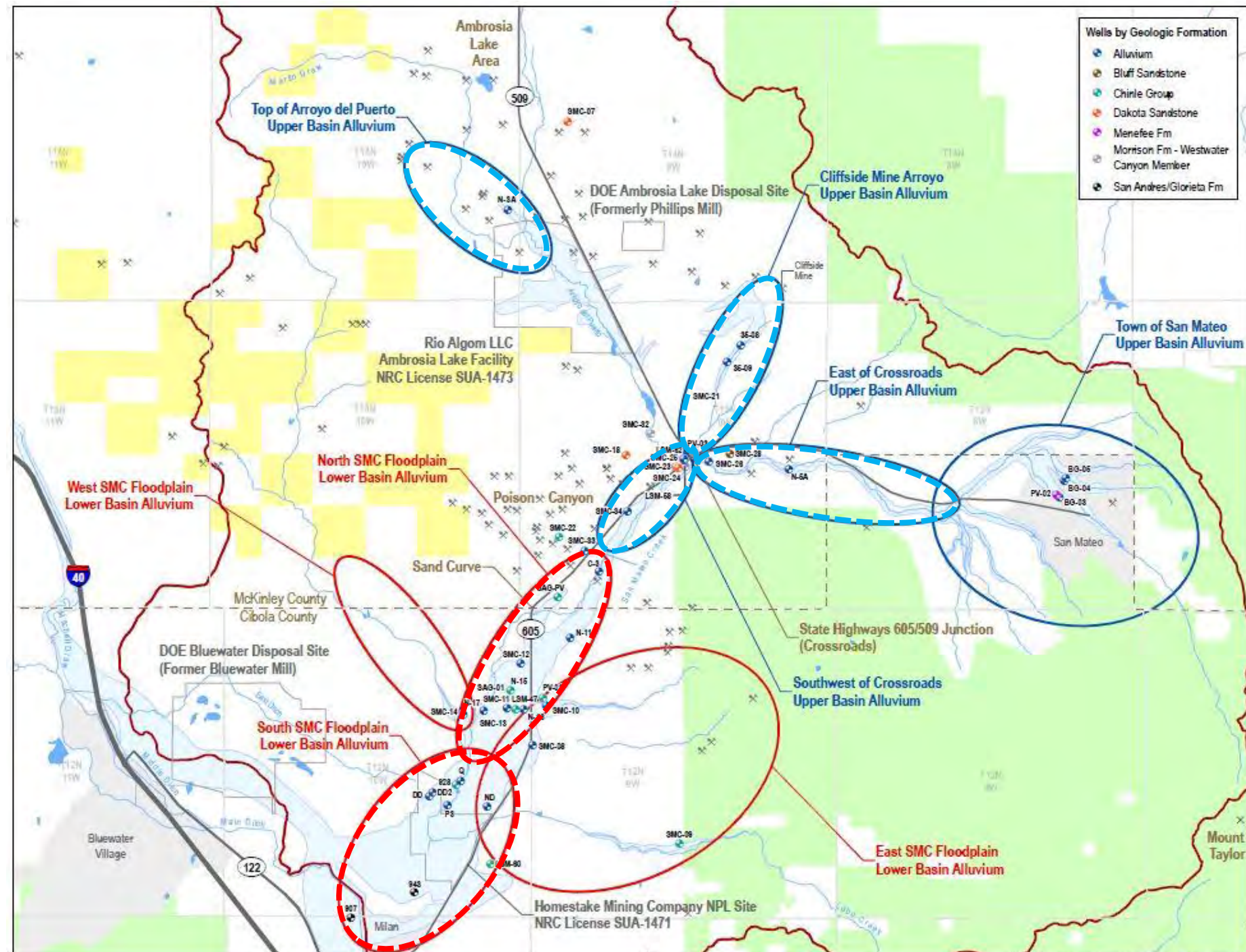
ALLUVIUM UPGRADIENT OF HOMESTAKE

Lines of Evidence for Impact

-  Water Quality
-  Major Ion Chemistry
-  Sulfur Isotope Ratio
-  Uranium Activity Ratio ?
-  USGS Sample Data







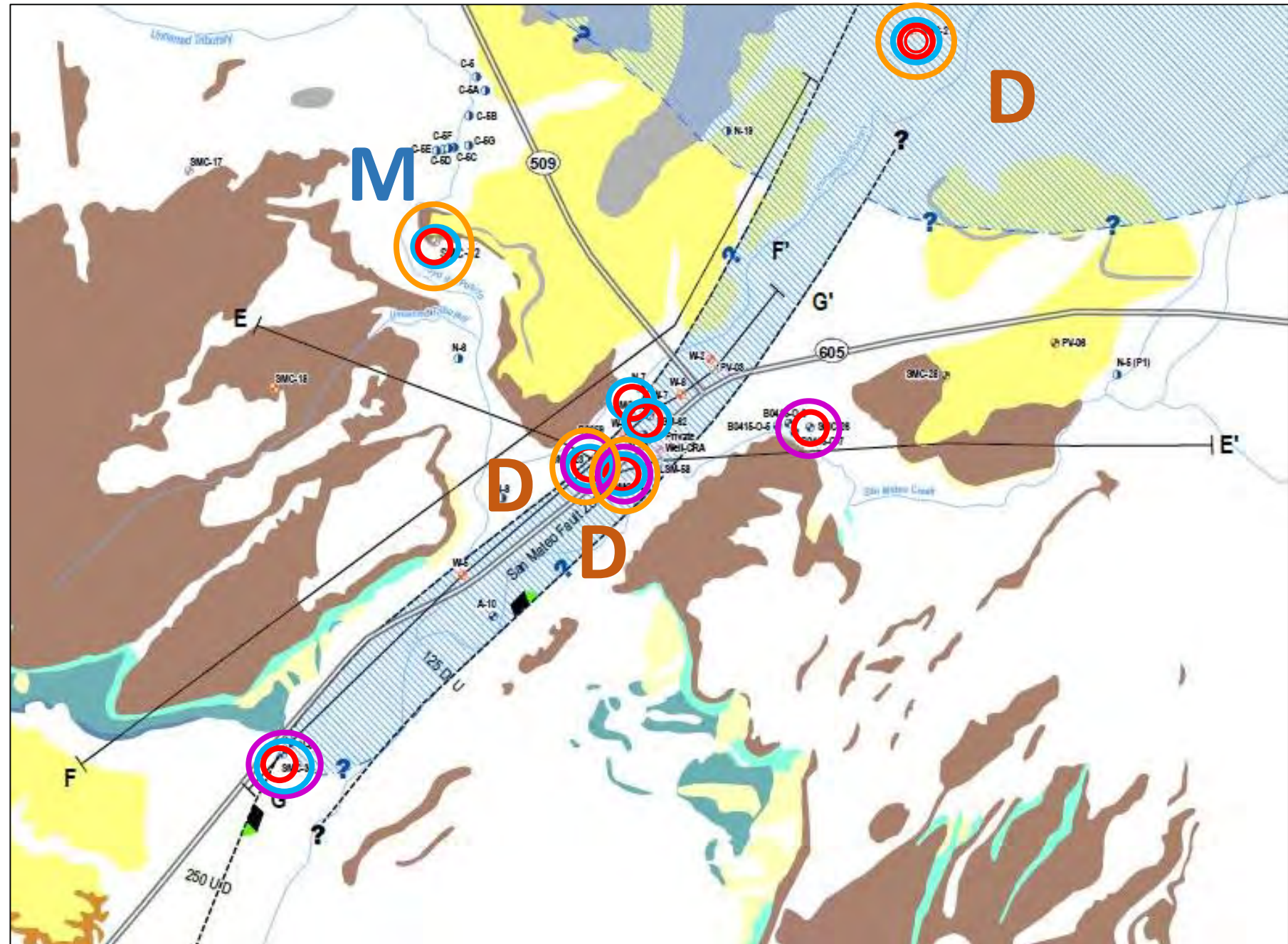
ALLUVIUM AREAS IMPACTED BY MINE DISCHARGE WATER







ALLUVIUM DAKOTA SANDSTONE AND MORRISON FM AREAS

Lines of Evidence
for Impact

-  Major Ion Chemistry
-  Trilinear Diagram
-  Sulfur Isotope Ratio
-  Hydraulic



DAKOTA SANDSTONE SATURATION MAP

-  Navajo Land
-  Dakota Sandstone Outcrop
-  Dakota Saturation
-  Phase 2 Dry Borehole



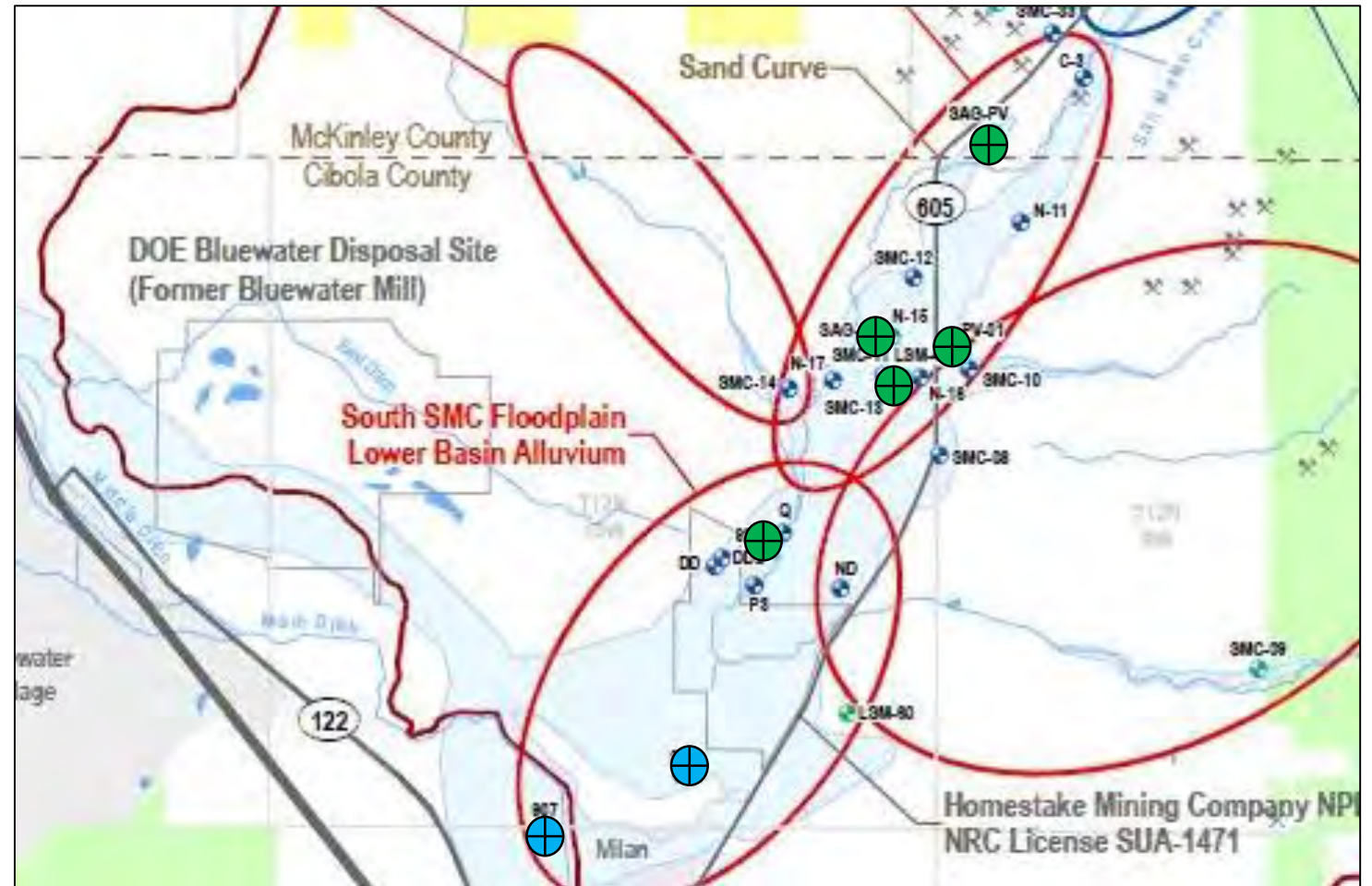
PART A SUMMARY

- ALLUVIAL AQUIFER LIKELY IMPACTED
 - Upper and Lower Basin
- DAKOTA, MORRISON LIKELY IMPACTED
 - Crossroads Area
- CONCEPTUAL SITE MODEL
 - Recharge of Bedrock Aquifers by MDW an Important Component
 - At Subcrop Areas
- SAN MATEO FAULT ZONE – IMPORTANT STRUCTURAL FEATURE?
- MDW POTENTIAL FUTURE THREAT TO PRIVATE WELLS AND MUNICIPAL WATER SUPPLY WELLS

WHERE WE DO NOT SEE EVIDENCE OF MINING IMPACT

- LOWER BASIN
BEDROCK
FORMATIONS

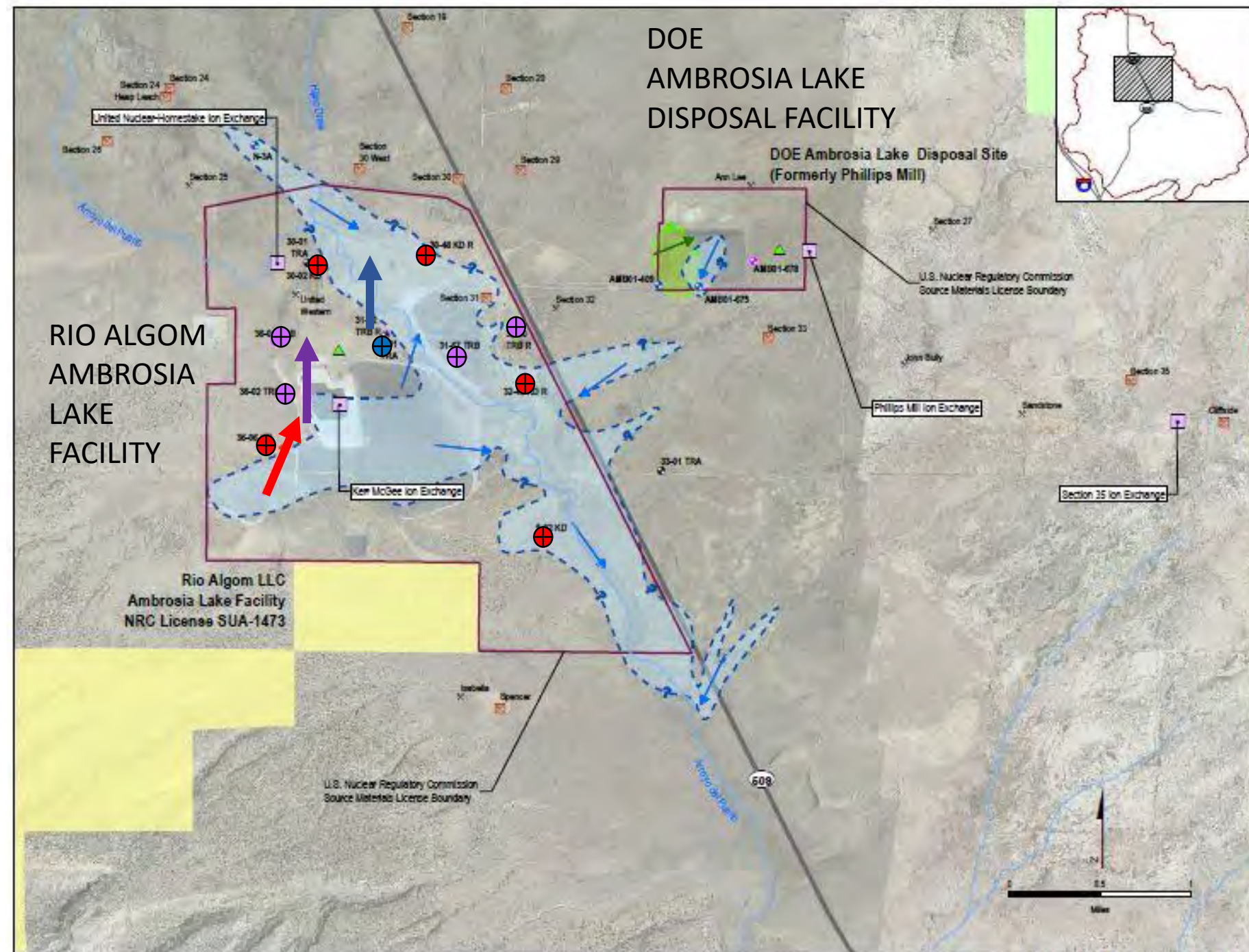
- Chinle Group North of Homestake
- San Andres/Glorieta Formations South of Homestake



LOWER BASIN

AMBROSIA LAKE AREA

Tre Hermanos B GW Flow

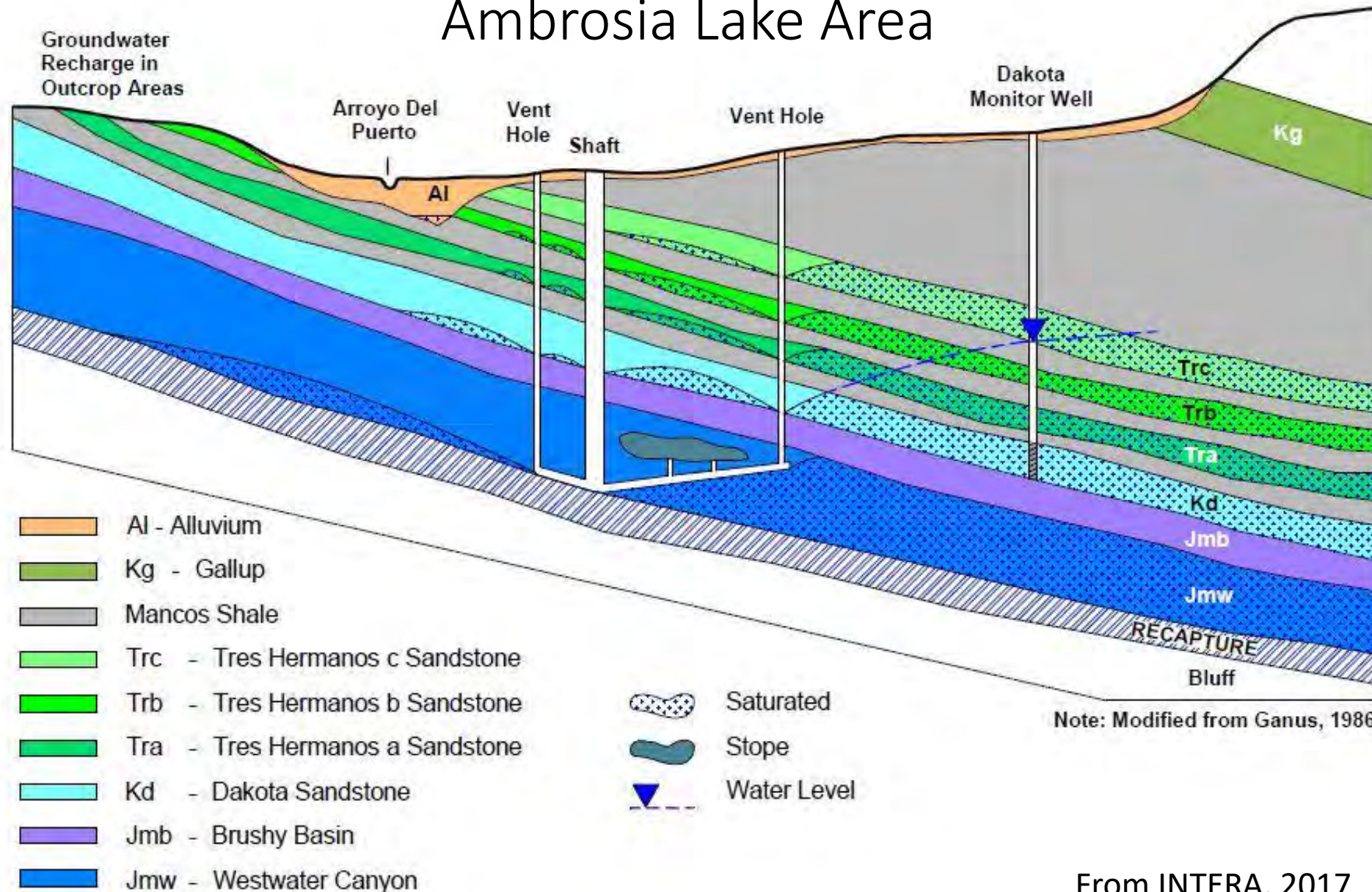


CONCEPTUAL SITE MODEL

Southwest

Northwest

Ambrosia Lake Area



CONTOURS OF OBSERVED WATER LEVELS WESTWATER CANYON MEMBER AQUIFER



Rio Algom Ambrosia Lake Disposal Facility

Alternate Concentration Limits

CONSTITUENT	DAKOTA SANDSTONE	TRE HERMANOS A SANDSTONE	TRE HERMANOS B SANDSTONE	ALLUVIUM	FEDERAL MCL /NM GW STANDARD
URANIUM (mg/L)	1.60	No ACL	1.60	23.0	0.03
THORIUM-230	945	945	945	13,627	--
TOTAL RADIUM (pCi/L)	218	218	218	3,167	5.0
LEAD-210 (pCi/L)	88	88	88	1,274	--
GROSS ALPHA (pCi/L)	No ACL	No ACL	No ACL	8,402	15
MOLYBDENUM (mg/L)	No ACL	No ACL	No ACL	176	1.0
NICKEL (mg/L)	6.8	No ACL	6.8	98	0.2
SELENIUM (mg/L)	No ACL	No ACL	No ACL	49	0.05
CHLORIDE (mg/L)	3,200	1,070	2,810	7,110	250
NITRATE (mg/L)	22.8	9.2	7.7	351	10
SULFATE (mg/L)	6,480	2,584	4,760	12,000	600
TDS (mg/L)	14,100	6,400	11,700	26,100	1,000



MARK PURCELL
SUPERFUND DIVISION
USEPA REGION 6
DALLAS, TX

Purcell.mark@epa.gov

Office: 214-665-6707

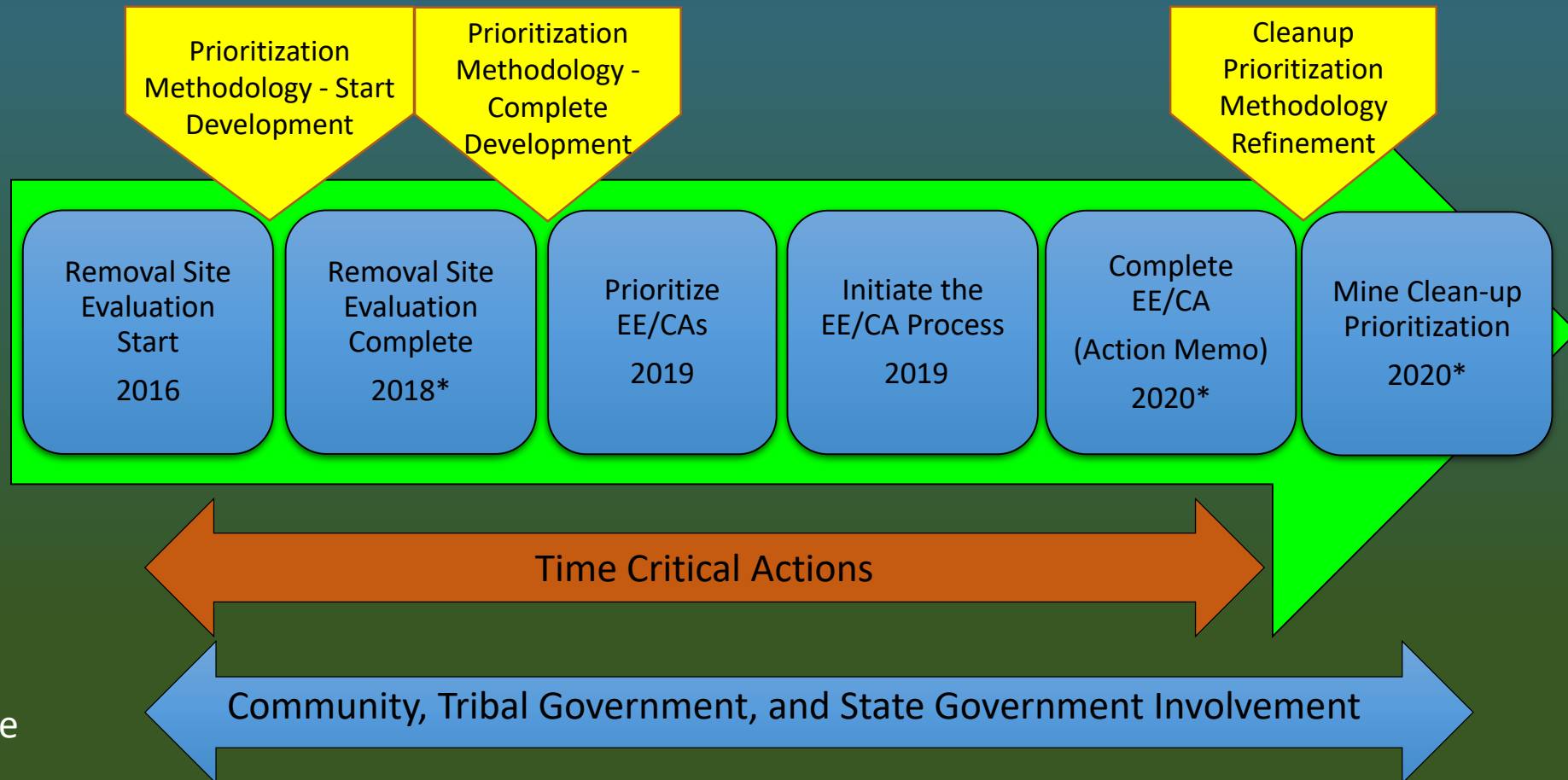


Tronox NAUM

Proposed Mine Evaluation Prioritization Risk Factors

November 5, 2018

Tronox Timeline Assessment to Clean-up Prioritization



*Indicates a OIG
commitment date

Objective



Establish a methodology to prioritize Tronox AUMs, based on a common set of risk factors and to help guide decisions regarding the expenditure of Tronox resources.

Methodology



- Scoring Scenarios identified for each risk factor.
- Risk factors will be scored based on data and information gathered through the RSEs and EE/CAs.
- Considerations other than risk may also be used to guide decisions related to cleanup strategies and timing.
- Mines that form a natural grouping will be scored and ranked as a single site.

Overview of the Factors

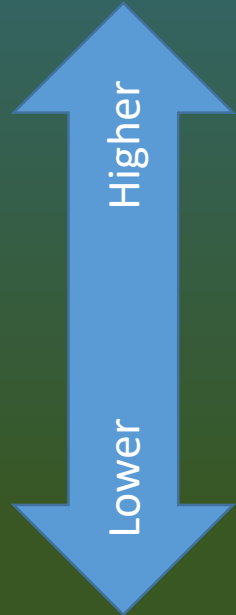


- Surface Radiation Level Above Background Investigation Level
- Migration to Surface Water
- Impacts to Ground Water
- Current Land-Use
- Accessibility
- Area of Contamination

Surface Radiation Level Above Background Investigation Level*



- Mean Gamma Radiation Survey Results (counts per minute) based on total mine surface scan:



Greater than 7x Times Above Background

Less/equal to 7x Times Above Background Investigation Level

Less/equal to 5x Times Above Background Investigation Level

Less/equal to 3x Times Above Background Investigation Level

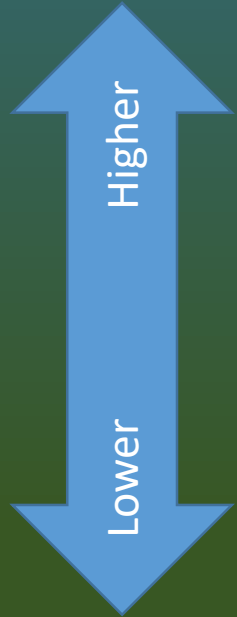
At or Below Background Investigation Level

Surface Radiation Level Above Background Investigation Level	Potential Impacts	Priority Score	Comments and Observations
Mean gamma radiation survey result for the total mine survey area of the mine is greater than 7x times above background investigation level	10		
Mean gamma radiation survey result for the total mine survey area of the mine is at or below 7x times and greater than 5x times above background investigation level	8		
Mean gamma radiation survey result for the total mine survey area of the mine is at or below 5x times and greater than 3x times above background investigation level	6		
Mean gamma radiation survey result for the total mine survey area of the mine is above background and at or below 3x times background investigation level	4		
Mean gamma radiation survey result for the total mine survey area of the mine is at or below background investigation level	0		

Migration to Surface Water



- Contaminated material migrating off-site into surface water (perennial or ephemeral) or proximity to surface water.



Surface water flowing through the site or immediately adjacent to contamination or in contact with mine waste.

Likely (surface water within 200 feet)

Possible (surface water within 500 feet)

Unlikely (surface water further then 1000 feet)

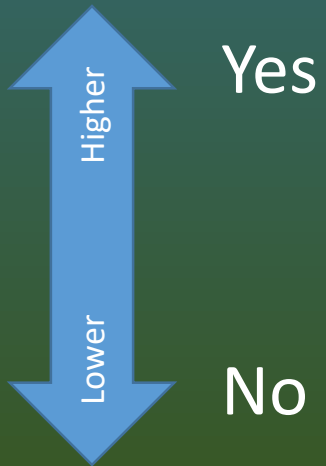
None

Migration to Surface Water Factor	Potential Impacts (perennial/ephemeral)		Priority Score	Comments and Observations
Surface water (perennial or ephemeral) flowing through the site or mine waste located in a surface water body	10	5		
Mobile material within 200 feet of surface water (perennial or ephemeral) or surface water (perennial or ephemeral) within 200 feet of disturbed mine waste	8	4		
Mobile material within 500 feet of surface water (perennial or ephemeral) or surface water (perennial or ephemeral) within 500 feet of disturbed mine waste	6	3		
Mobile material within 1000 feet of surface water (perennial or ephemeral) or surface water (perennial or ephemeral) within 1000 feet of disturbed mine waste	4	2		
No known or potential for surface water (perennial or	0	0		

Impact to Ground Water



- The mine workings were below the water table or the mine is within a watershed with known impacts to ground water.

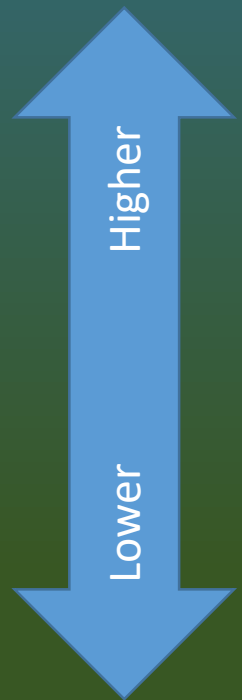


Impact to Ground Water	Potential Impacts	Priority Score	Comments and Observations
The mine workings were below the water table or the mine is within a watershed with known impacts to ground water.	5		
The mine workings were not below the water table or the mine is not within a watershed with known impacts to ground water.	0		

Current Land-Use



- Land-use of the site.



Residential

Cultural/Agricultural/Grazing

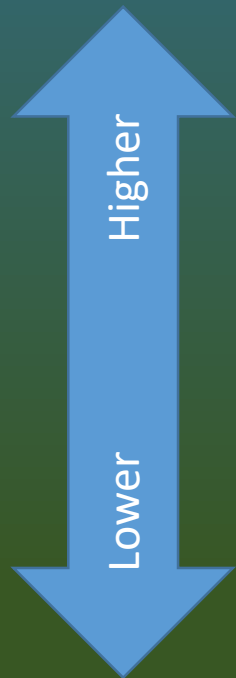
Recreational

Current Land-Use Factor	Potential Impacts	Priority Score	Comments and Observations
Current residential use	10		
Current Cultural/Agricultural/Grazing use	5		
Recreational	2		

Accessibility



- Ease of gaining access to the site



Mine is readily accessible from a maintained road using a standard two-wheel drive passenger vehicle or by walking

Not accessible by standard two-wheel drive passenger vehicle; accessible by four-wheel drive vehicle or a utility task vehicle

Mine access requires a moderate hike across relatively flat terrain of less than 1 mile

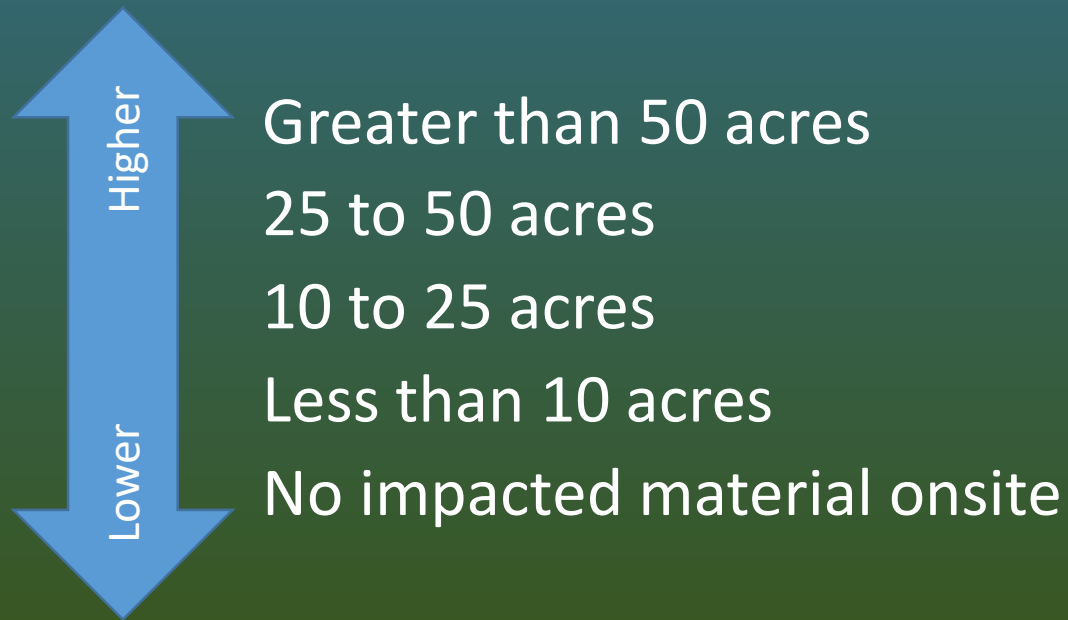
Mine access requires a hard hike (e.g. heavy vegetation, grade greater than 10% slope, no defined trail, etc.) of greater than 1 mile to access the mine

Accessibility Factor	Potential Impacts	Priority Score	Comments and Observations
Mine is readily accessible from a maintained road using a standard two-wheel drive passenger vehicle or by walking	5		
Not accessible by standard two-wheel drive passenger vehicle; accessible by four-wheel drive vehicle or a utility task vehicle	4		
Mine access requires a moderate hike across relatively flat terrain of less than 1 mile	3		
Mine access requires a hard hike (e.g. heavy vegetation, grade greater than 10% slope, no defined trail, etc.) of greater than 1 mile to access the mine	2		

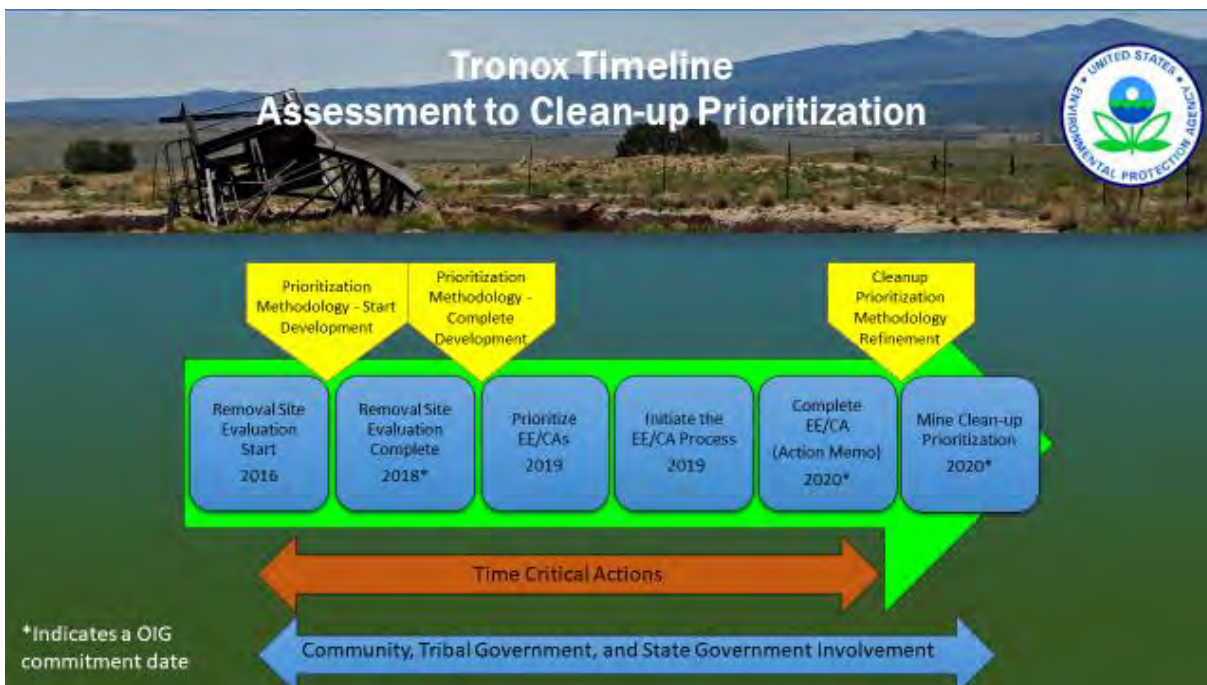
Area of Impacted Material



- Estimated area of significantly impacted soils and waste material



Area of Impacted Material Factor	Potential Impacts	Priority Score	Comments and Observations
Estimated area of the disturbed mine waste material, bore holes, and shafts, is greater than 50 acres	5		
Estimated area of the disturbed mine waste material, bore holes, and shafts, is 25 to 50 acres	4		
Estimated area of the disturbed mine waste material, bore holes, and shafts, is 10 to 25 acres	3		
Estimated area of the disturbed mine waste material, bore holes, and shafts, is less then 10 acres	2		
No impacted material onsite	0		



Risk Factors

1. Surface Radiation Level Above Background Investigation Level
2. Migration to Surface Water
3. Impacts to Ground Water
4. Current Land-use
5. Accessibility
6. Area of Contamination

Question to consider: What might others ask us about this factor if we were explaining the process and why a specific site ranks as it does? (Think about the different stakeholders)

1. Surface Radiation Level Above Background Investigation Level

2. Migration to Surface Water

3. Impacts to Ground Water

4. Current Land-use

5. Accessibility

6. Area of Contamination

7. General Prioritization process

Evapotranspiration Soil Covers

"Store and Release Cover Systems"

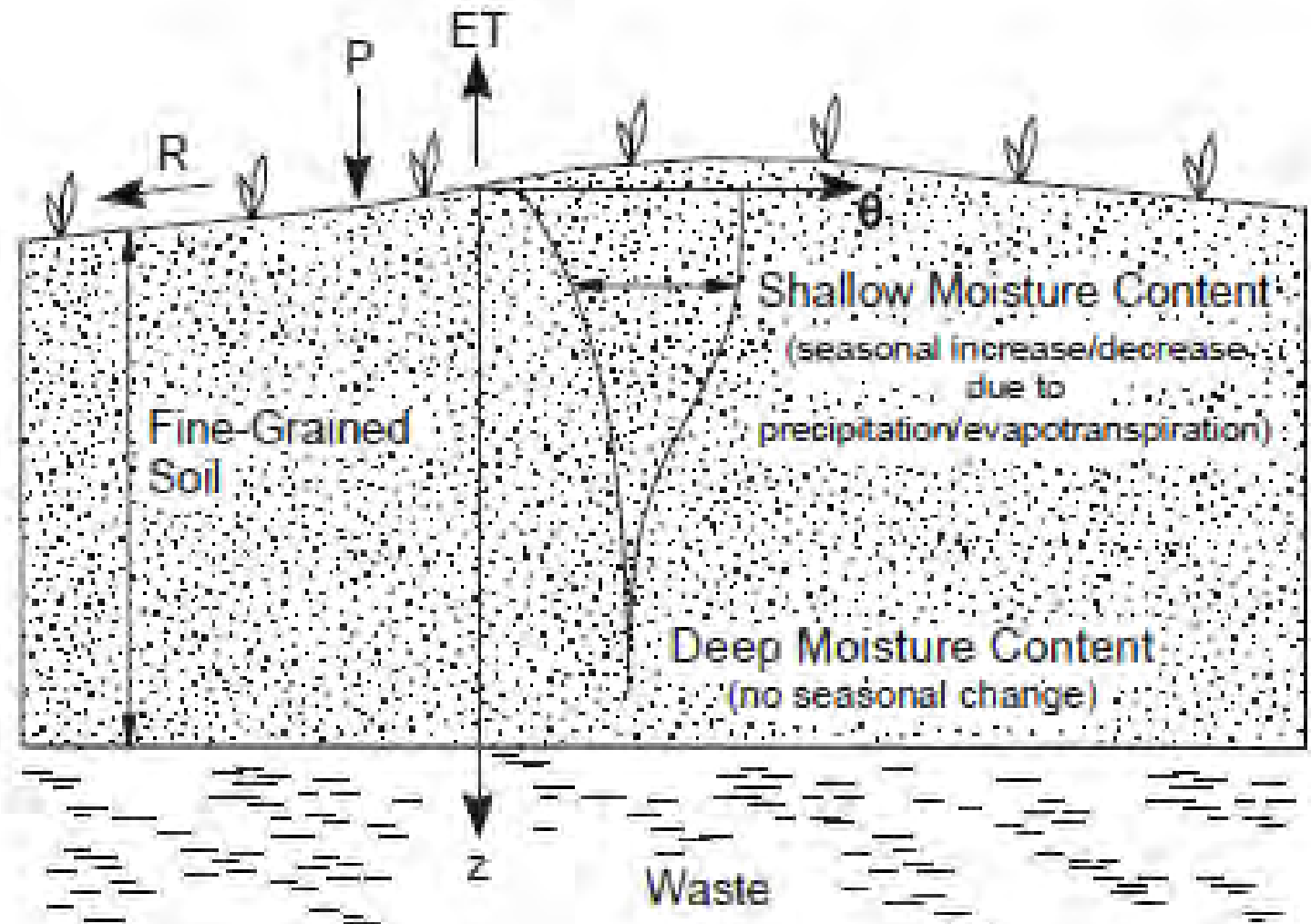
-
- *Cover systems - description and evolution*
 - *Function and appropriateness*
 - *Performance goals / requirements*
 - *Cover design considerations*
 - Climate
 - Soil Characteristics, and
 - Hydrologic Properties
 - *Performance monitoring*
 - *Thoughts on unsaturated flow cover modeling*



Conceptualized ET covers

"Store and Release cover System"

$$NP = P - ET \pm R \pm \Delta S$$



P = Precipitation

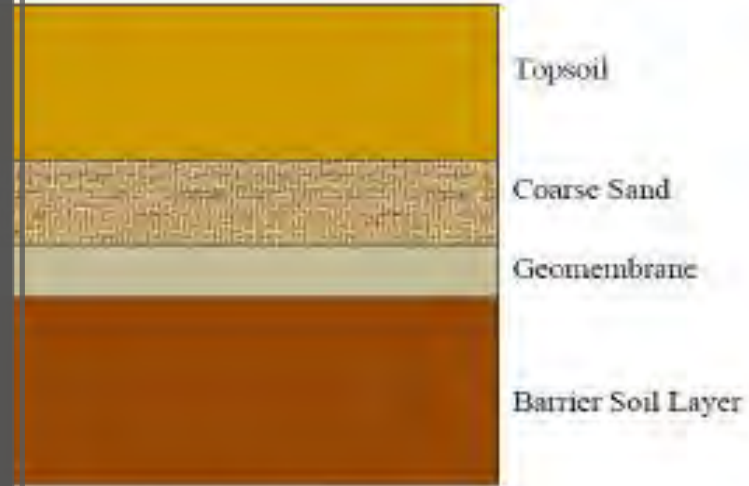
ET = Evapotranspiration

R = Runoff

θ = Volumetric Moisture Content

z = Depth

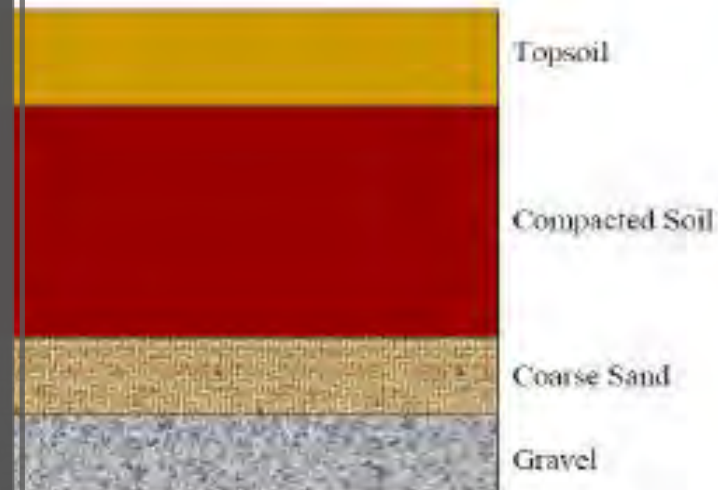
Evolution of ET covers



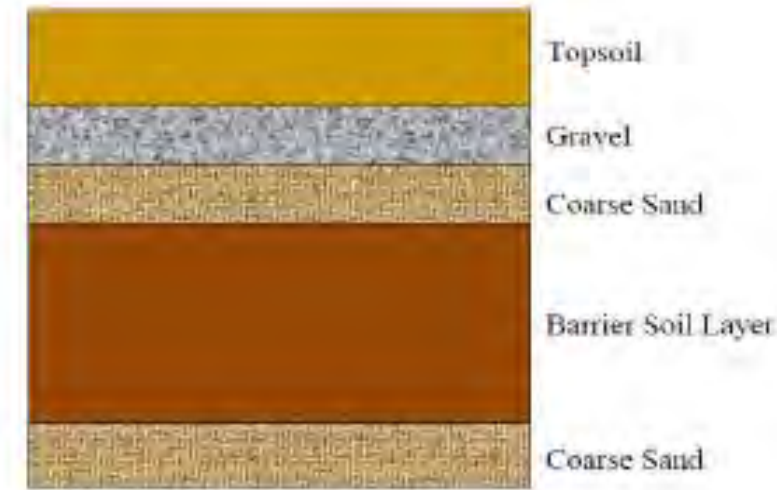
RCRA Subtitle C Cover



RCRA Subtitle D Cover



Anisotropic Barrier Cover



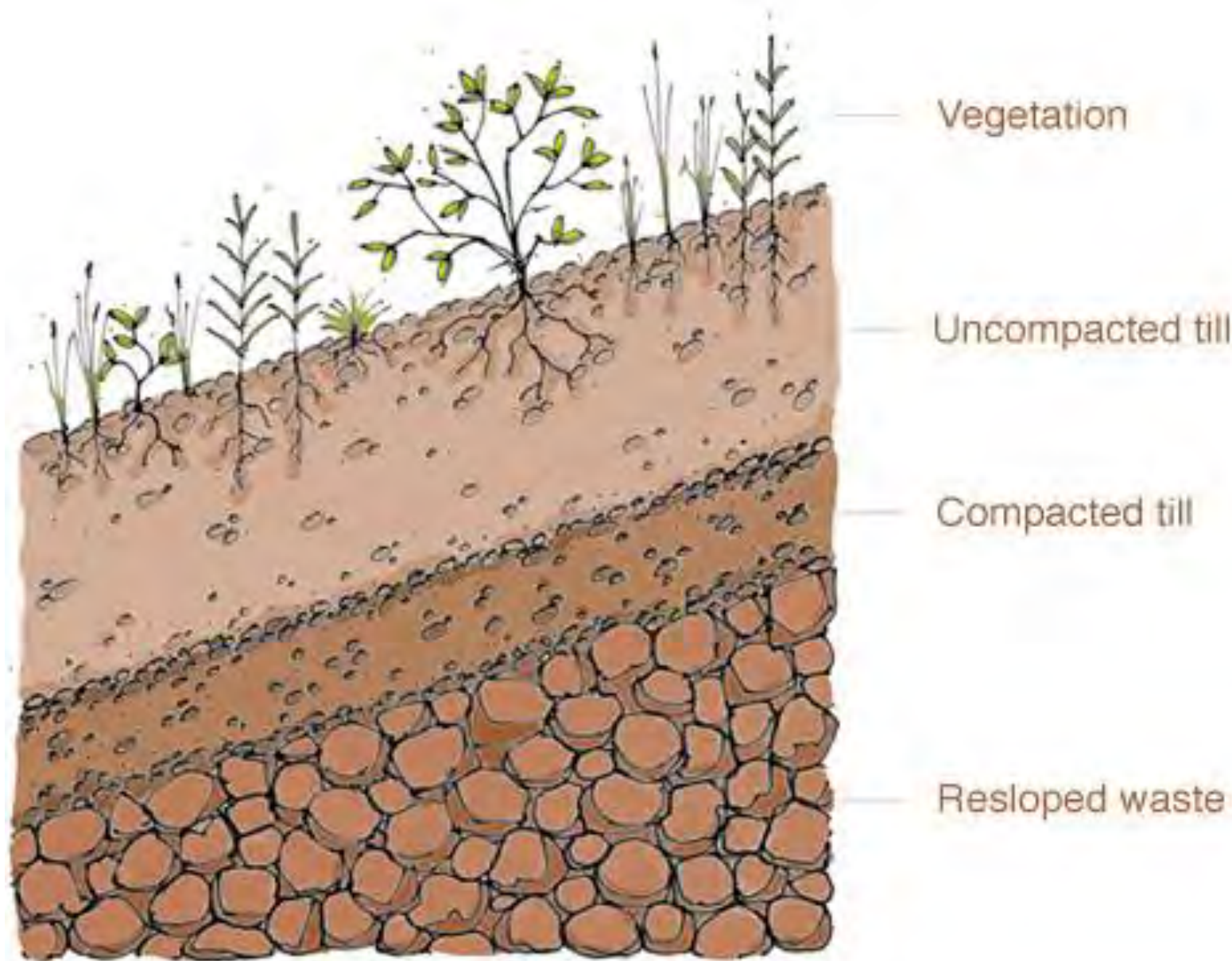
Capillary Barrier Cover

What was the

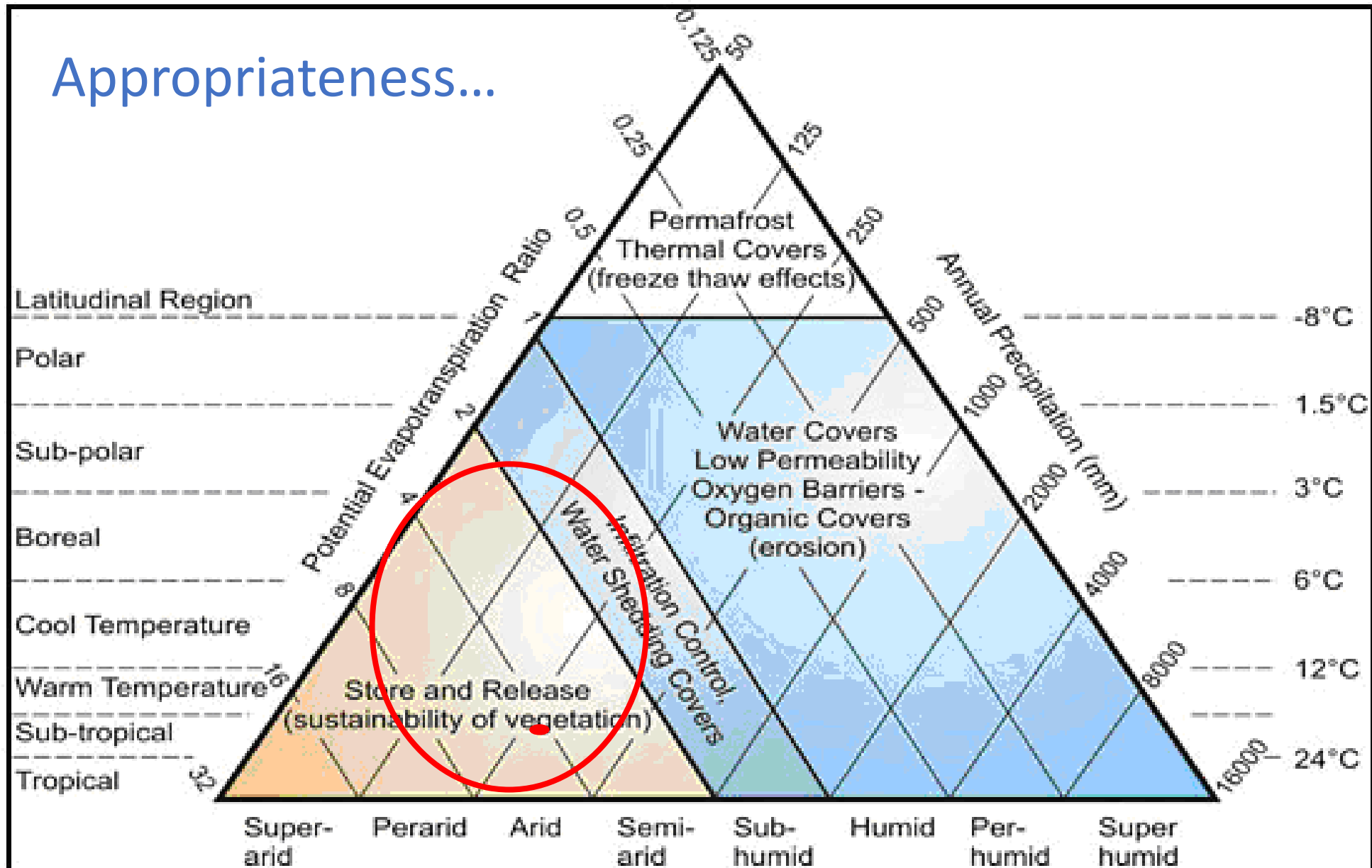
“Alternative Cover”, an ET Cover

Is now a

Store and Release Cover System



Appropriateness...

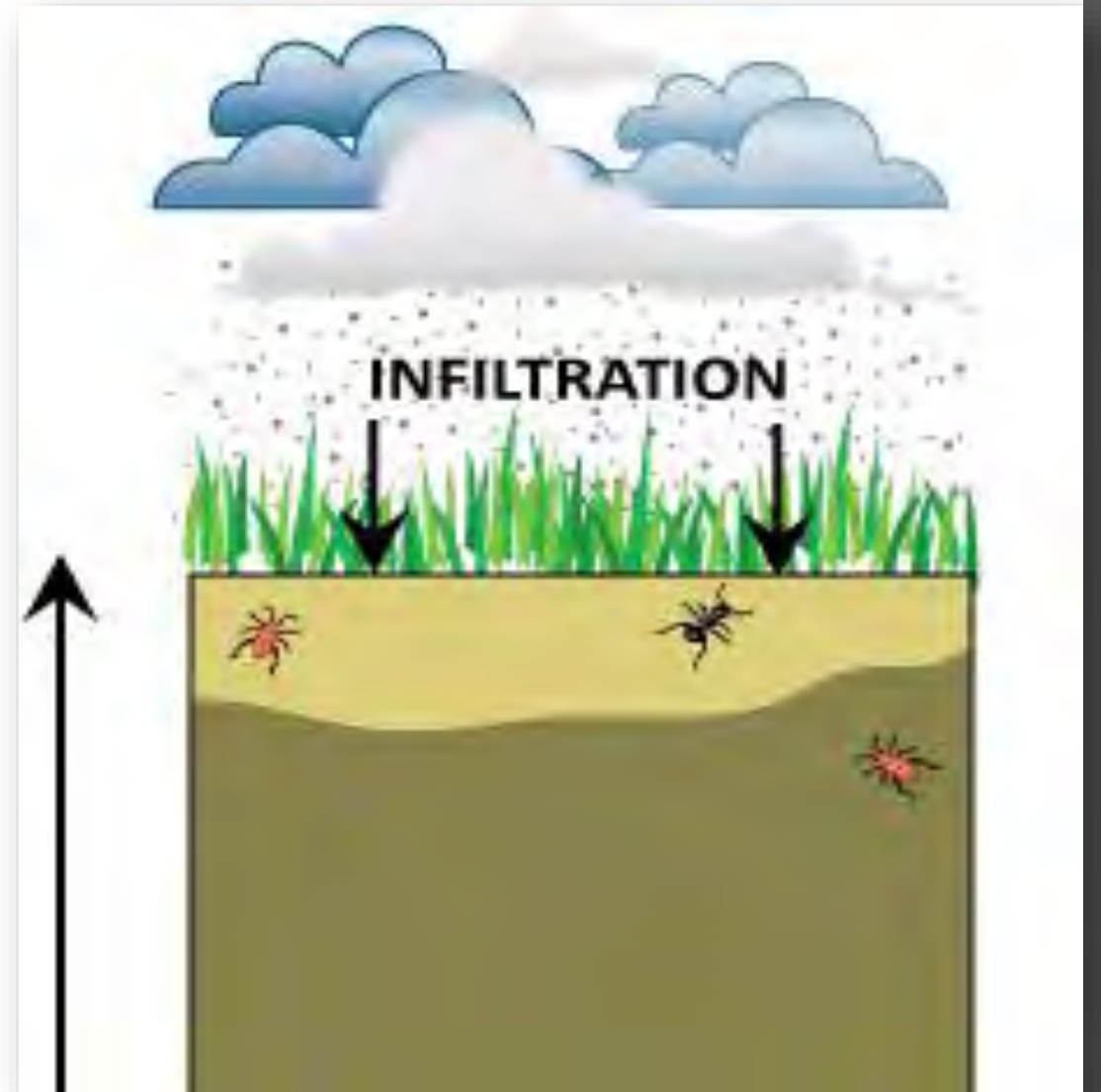
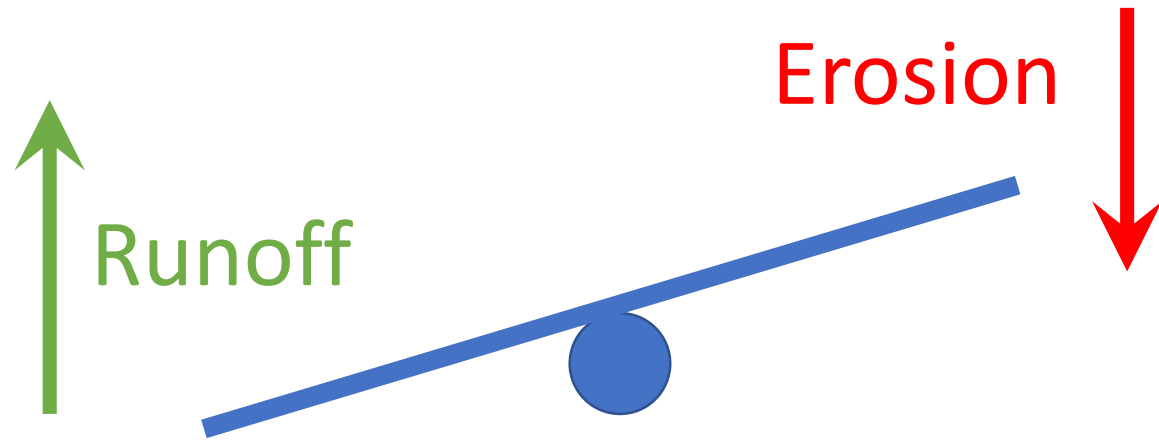


Appropriateness...



Cover Function #1:

- Minimize Erosion,
- Maximize Runoff,
- Capture Remaining



Cover Design – Hydrology

Infiltration - The vertical entry of water into the immediate surface of soil or other materials. Water moves under gravity and capillary forces (“suction”).

Infiltration Capacity - The maximum rate at which water can infiltrate into a soil under a given set of conditions.

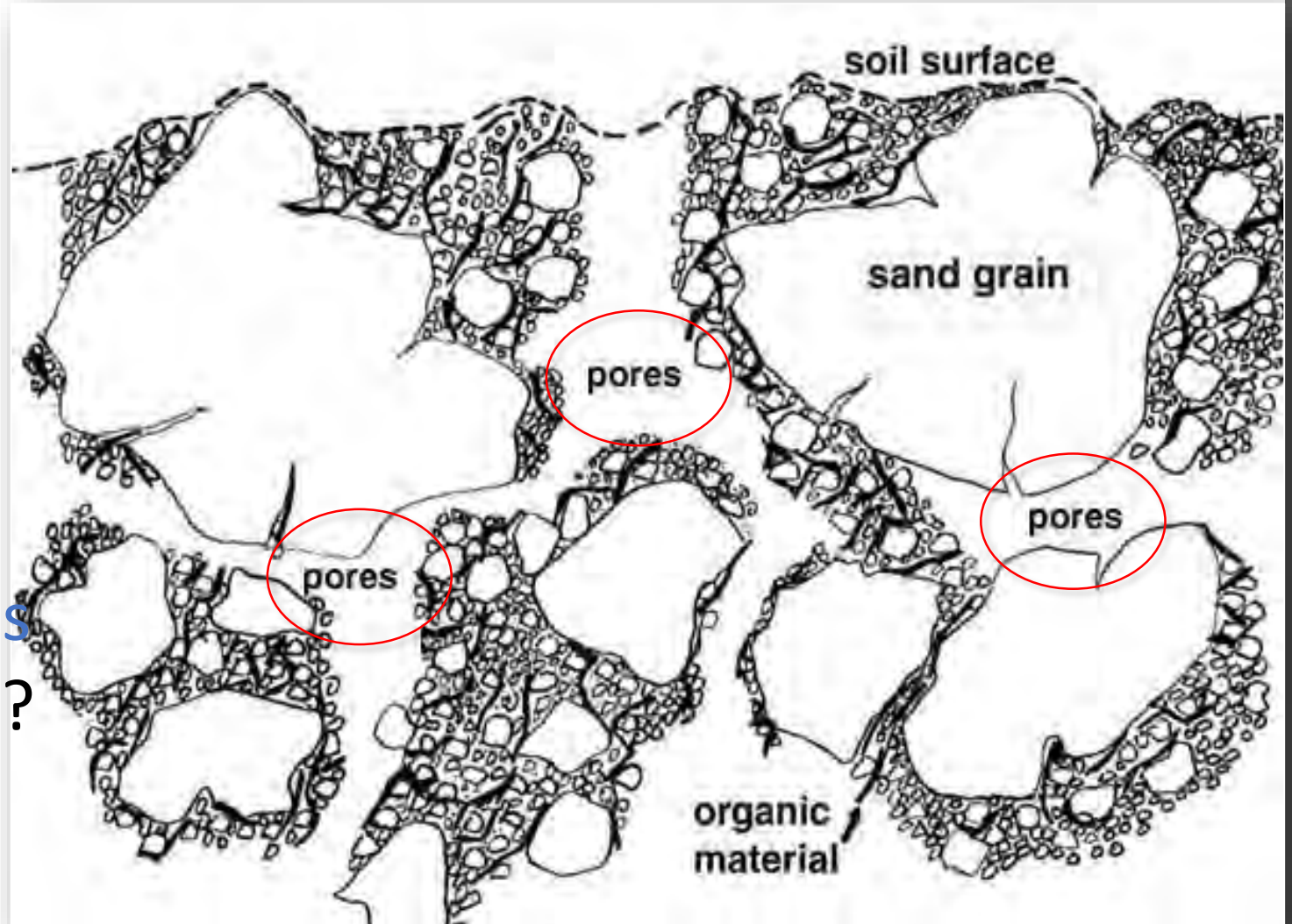
- ➔ The rate of infiltration is limited by the capacity of the soil and rate at which water is applied to the surface until K_{sat} is achieved

Percolation - **Vertical** and **Lateral** Movement of water through the soil by gravity.

Cover Function #2:

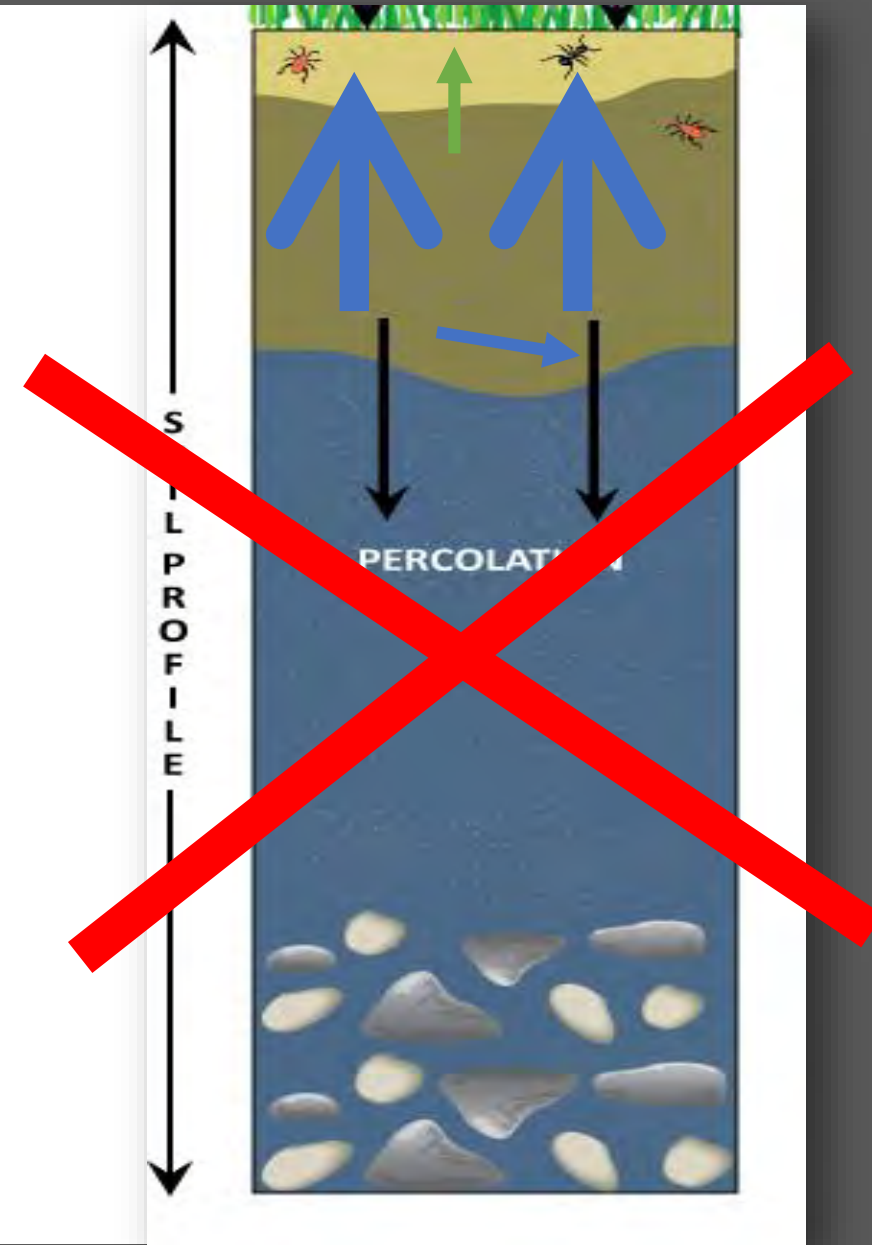
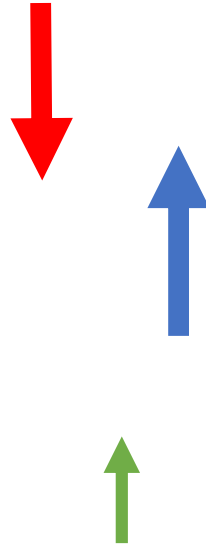
Maximize Storage

- Soil properties
 - PSD
- Engineering design
 - monolithic?
- Construction methods
 - compacted, ripped?



Cover Function #3:

- Minimize Percolation,
- Maximize Evaporation,
- Encourage Transpiration
- or lateral drainage



Performance Goals or Success Criteria

Must be Defined up-front!

Demonstrate a high probability of limiting net-percolation to less than 5% of mean annual precipitation for any given year...

Achieve a prescriptive storage criteria...

Ensure Groundwater standards are not exceeded in the future

Ensure plants are available for wildlife or erosion protection

Maintain cover to minimize dust – burrowing animals, radon etc...

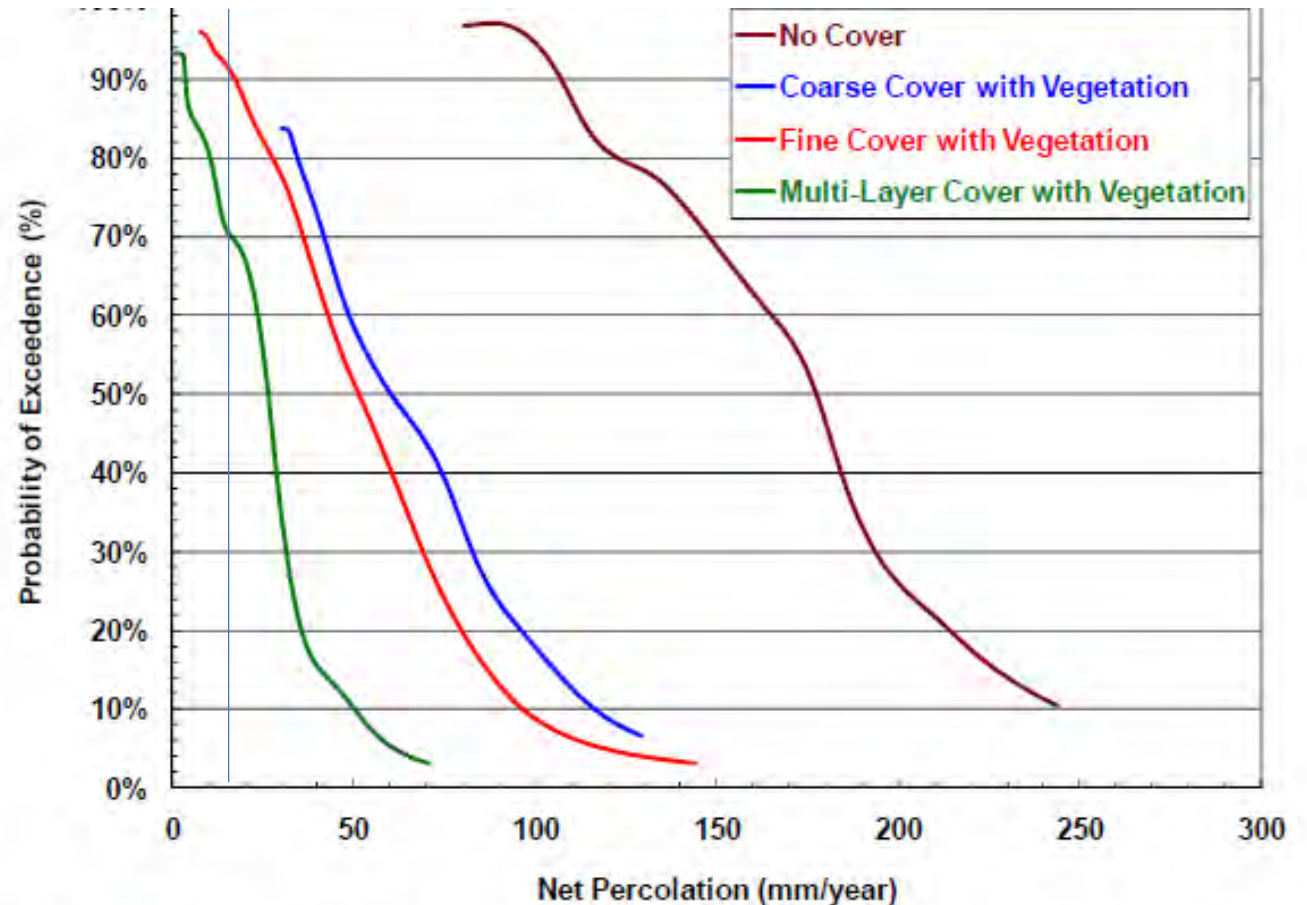


Figure 2 Example illustration of net percolation probability of exceedence curves generated from the results of continuous 100-year climate simulations for 'no cover' scenario, and three different cover system scenarios

Elements of Design

Important questions that typically need to be addressed when considering the design include: *first, identify success or performance criteria....*

then,

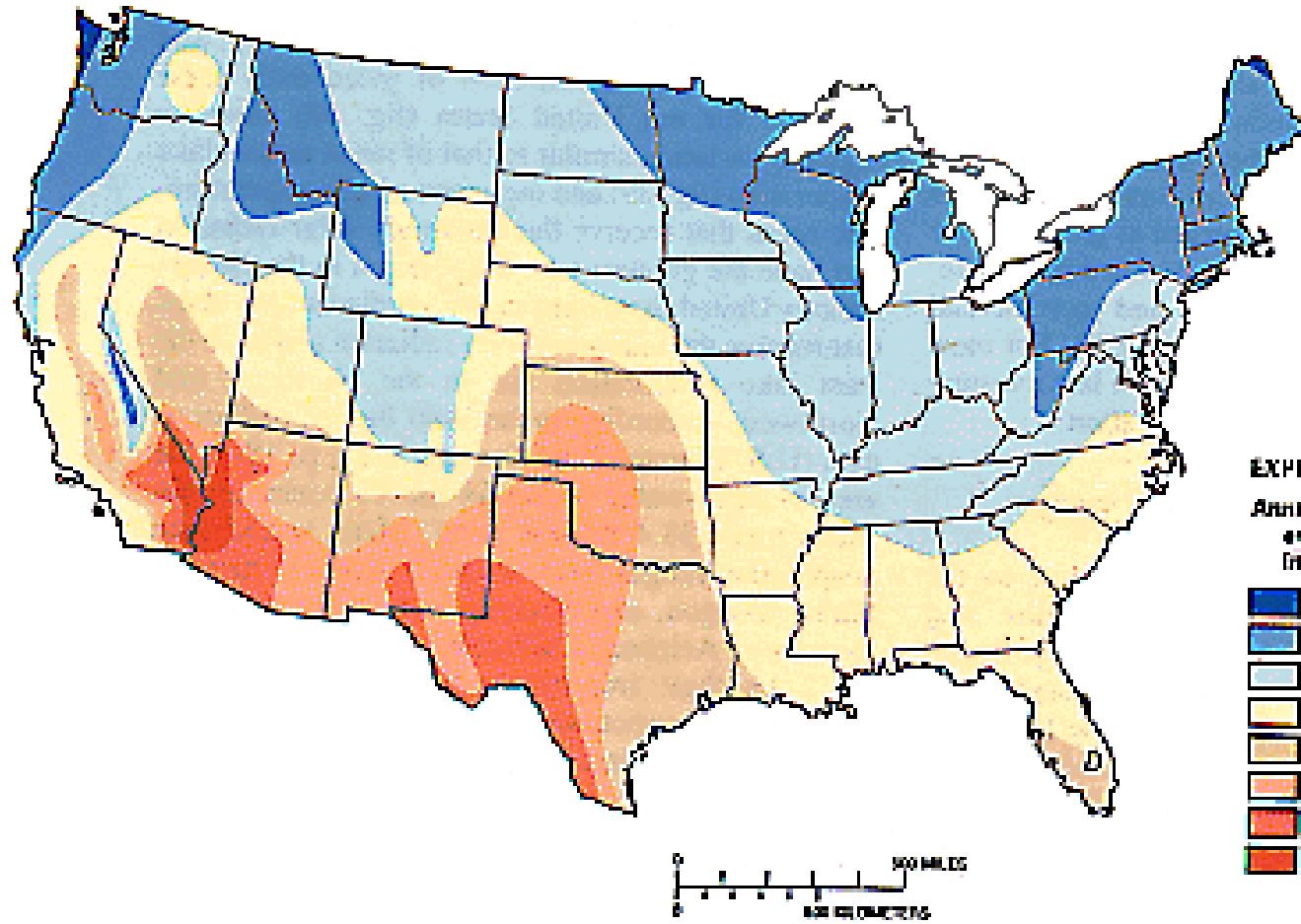
- What are the maximum design criteria - i.e., flow rate or percolation...?
- What materials are available for construction?
- Can the available materials be made to achieve the success criteria?
- Are materials uniform and have appropriate placement methods been determined, i.e., how should the system be constructed,
- What surface treatments should be applied to control erosion?
- Which plants should be established to promote transpiration and stabilize the cover surface?
- What type and frequency of maintenance and monitoring should be employed?

The **magic** cover *Thickness* question?

The required thickness of the protection layer depends on many factors including:

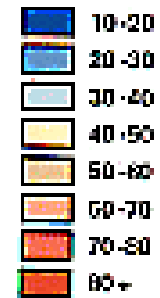
- Ability of a soil to temporarily store water in the upper layer to attenuate percolation into the underlying layers; - **highly material and climate specific!**
- the ability of a soil to allow transport to the atmosphere;
- need to prevent accidental human intrusion, bioturbation, or root penetration into underlying materials;
- need to support vegetative growth by accommodating plant roots;
- need to provide other types of protection unique to a particular waste (i.e., attenuate radon emissions), and;
- Need to prevent uptake and bioaccumulation at surface.

Cover Design - Climate

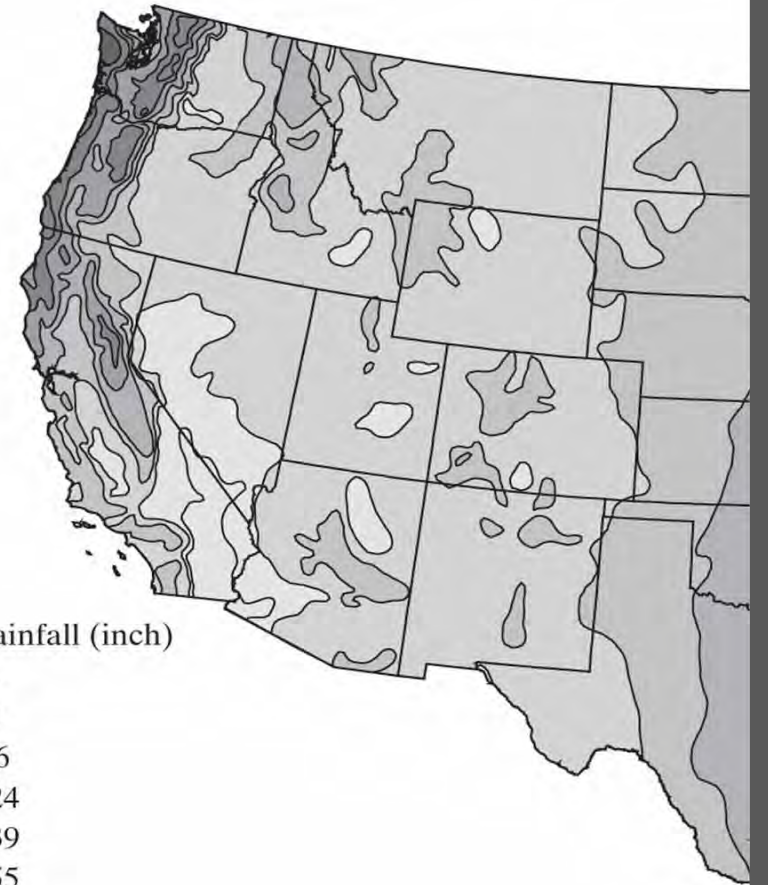
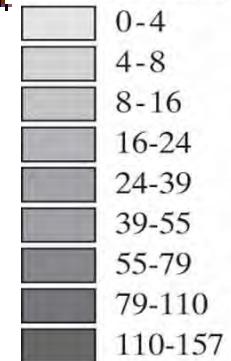


EXPLANATION

Annual lake evaporation, in inches



Annual Rainfall (inch)



Cover Design - Climate

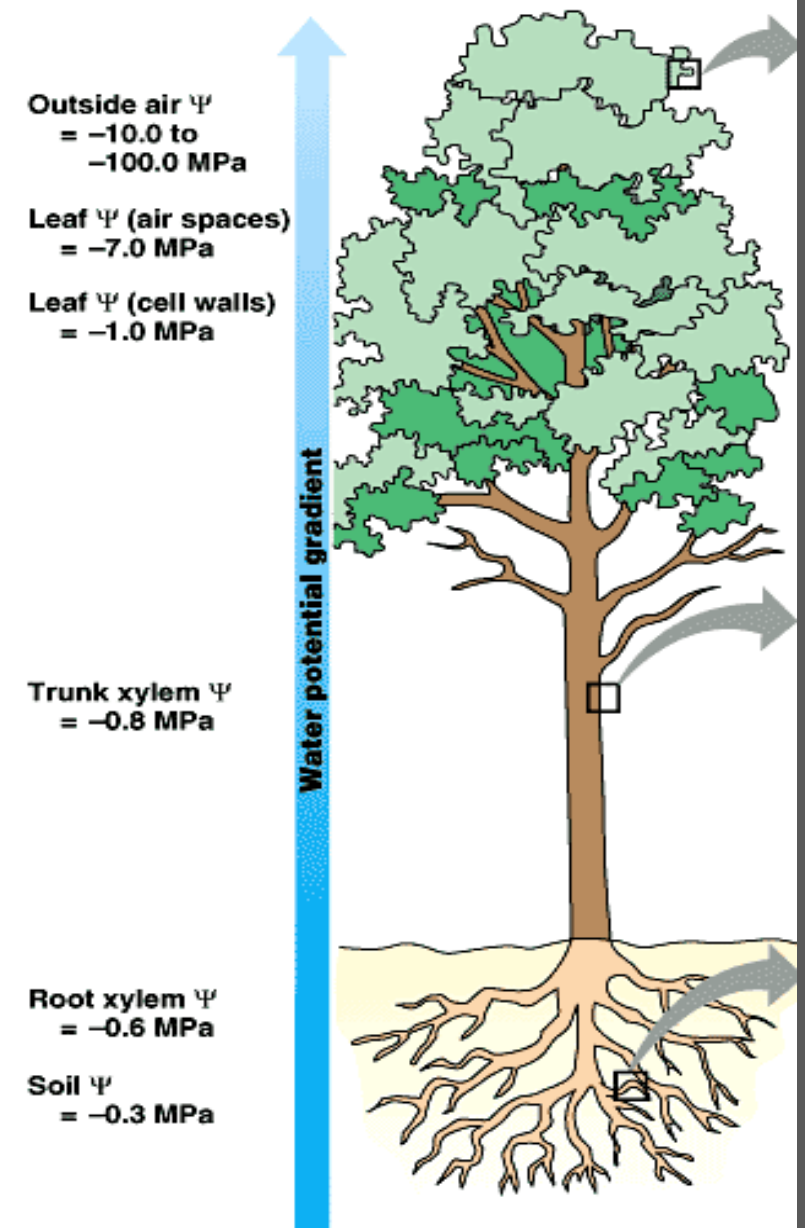
Evaporation & Transpiration



Evaporation = phase change from liquid water to water vapor.

Transpiration is the process by which water in plants is transferred to the atmosphere.

Evaporation is controlled by the humidity, temperature, and the ability of the porous media to transport water to the evaporation front.



- In **humid** to tropical climates or in densely planted crops, transpiration accounts for **55 to 90 percent of evapotranspiration** (depending on plant density - and the actual evaporation closely mimics the potential evaporation in wetlands) Bachand et al., 2013... Humidity is high and PE is low...



Cover Design – Hydrology – ET

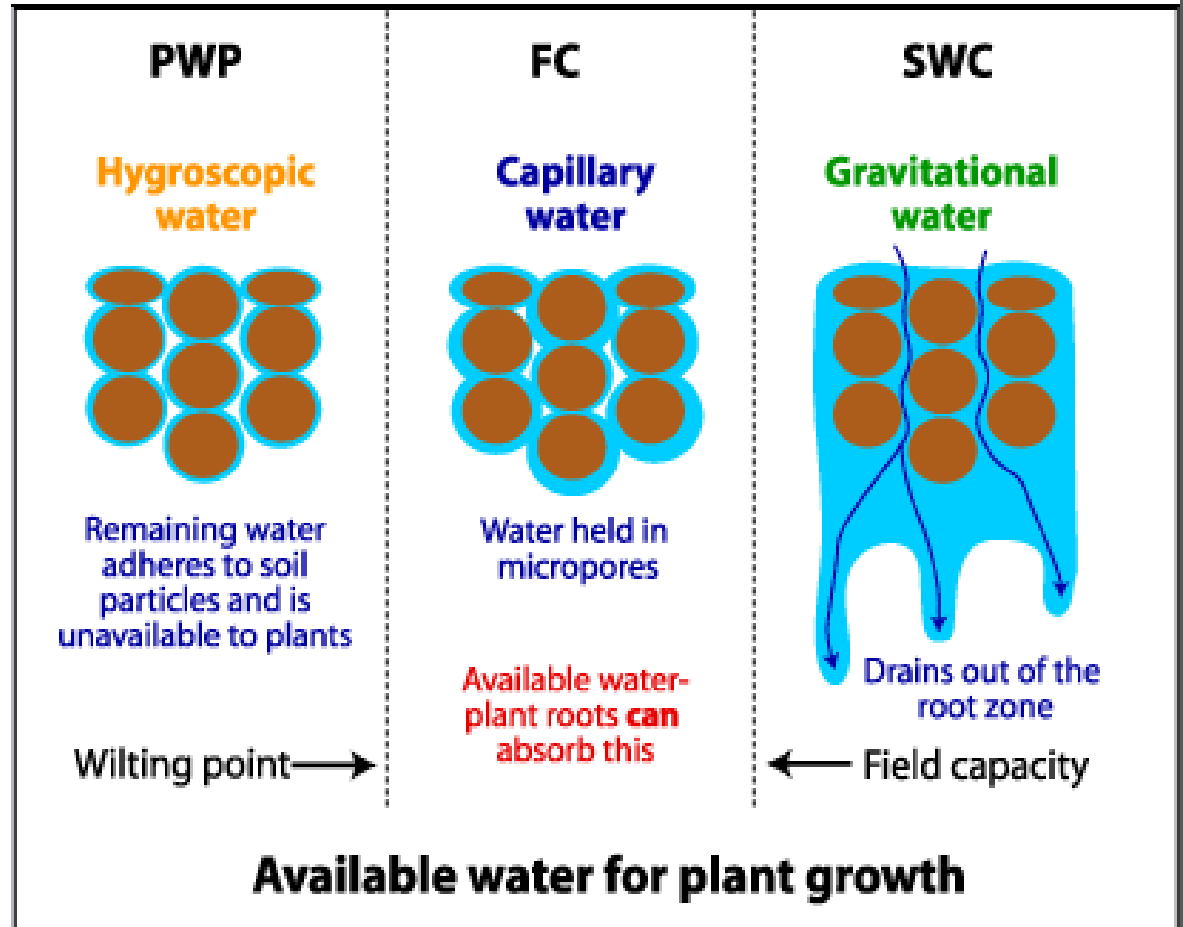
- In **semi-arid climates** with dense native vegetation, plants have been shown to account for a max of **4 to 7 percent of total ET** – i.e. 90 + percent is lost by evaporation.
Balugani et al., 2017
- Native, desert plants do well here because they can pull large matric suctions, outside of the PAWHC and they can simultaneously shut down day-time transpiration.
- Unless we plant non-natives, we can not rely on plants in any way *shape or form* as an effective tool In removing water from the system unless it is non-native or invasive.



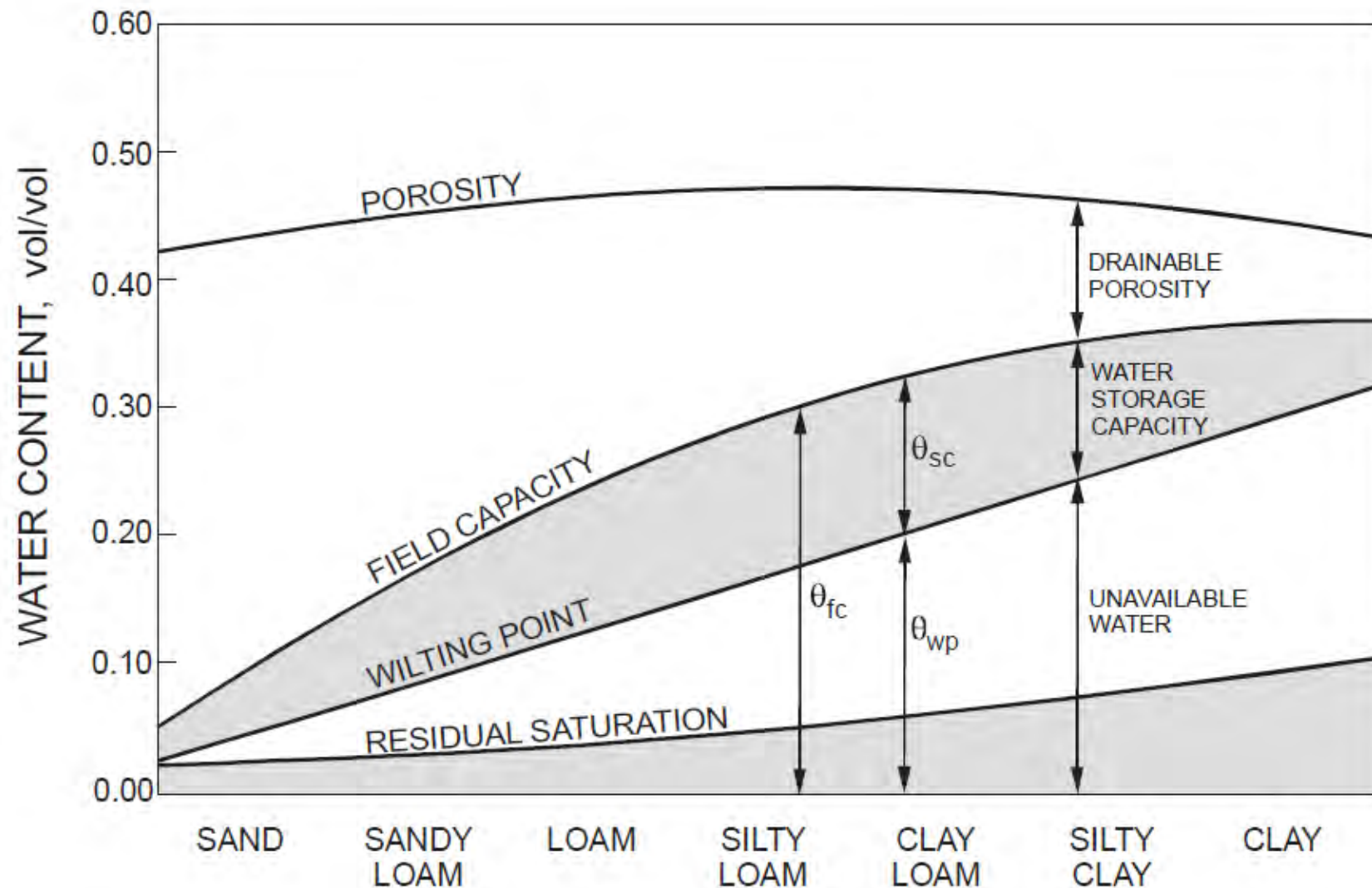
Cover Design – Hydrology – Soil Water

Types of available soil moisture

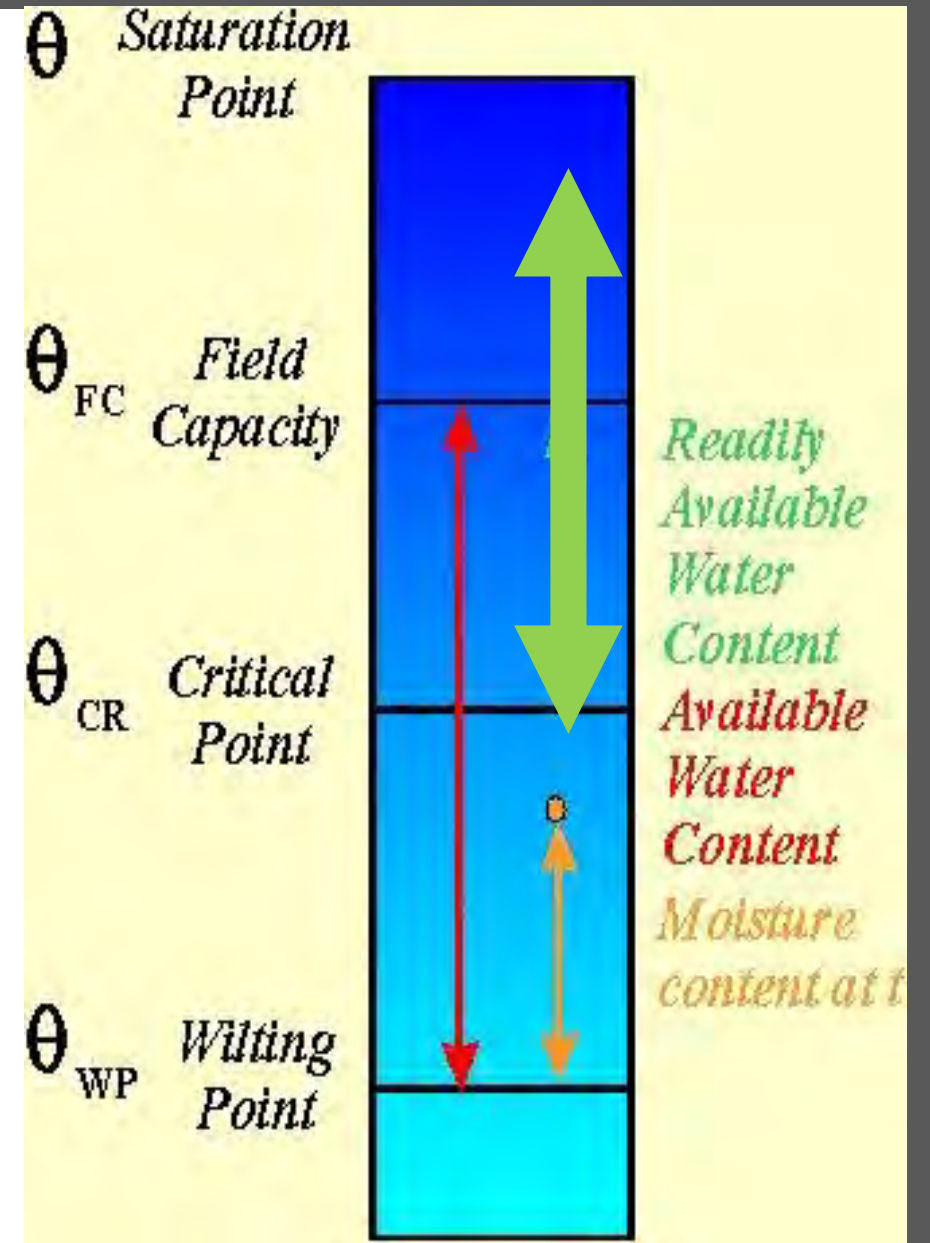
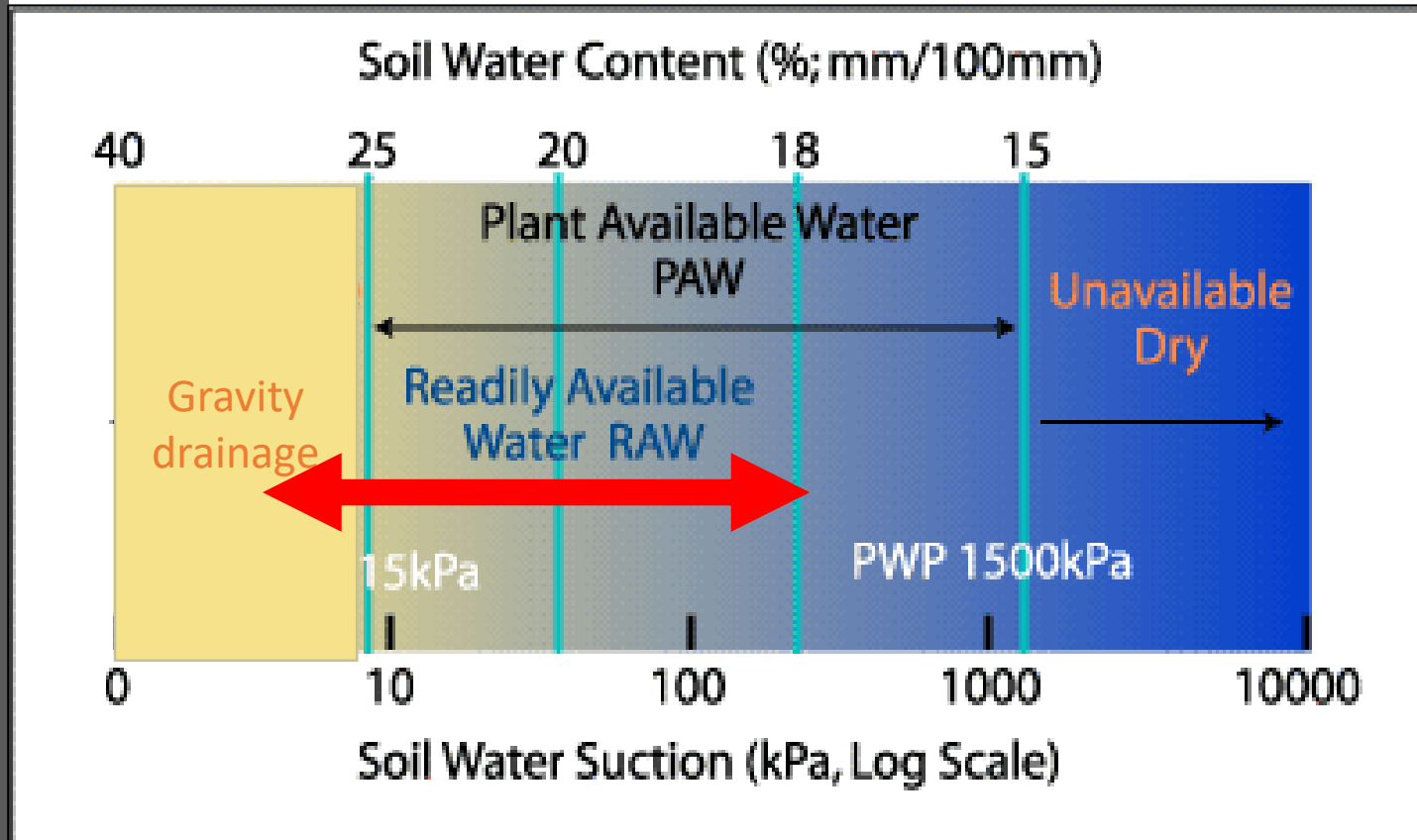
- Adsorbed and membranous water (hygroscopic water)
- Capillary water
- Gravitational water



Cover Design – Hydrology – Soil Water



Cover Design – Hydrology – Soil water availability



Cover Design – Hydrology – Soil Water potential

The amount of work that must be done per unit of a specified quantity of pure water in order to transport reversibly and isothermally an infinitesimal quantity of water from a specified source to a specified destination.

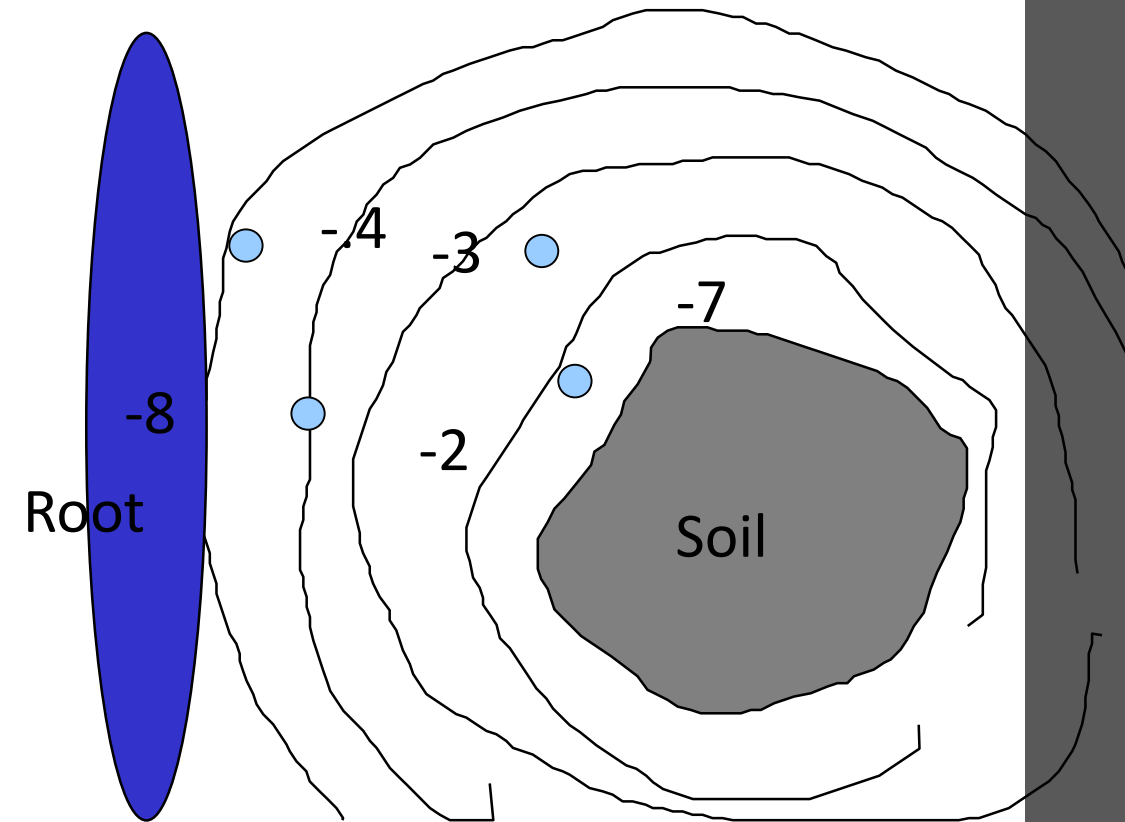
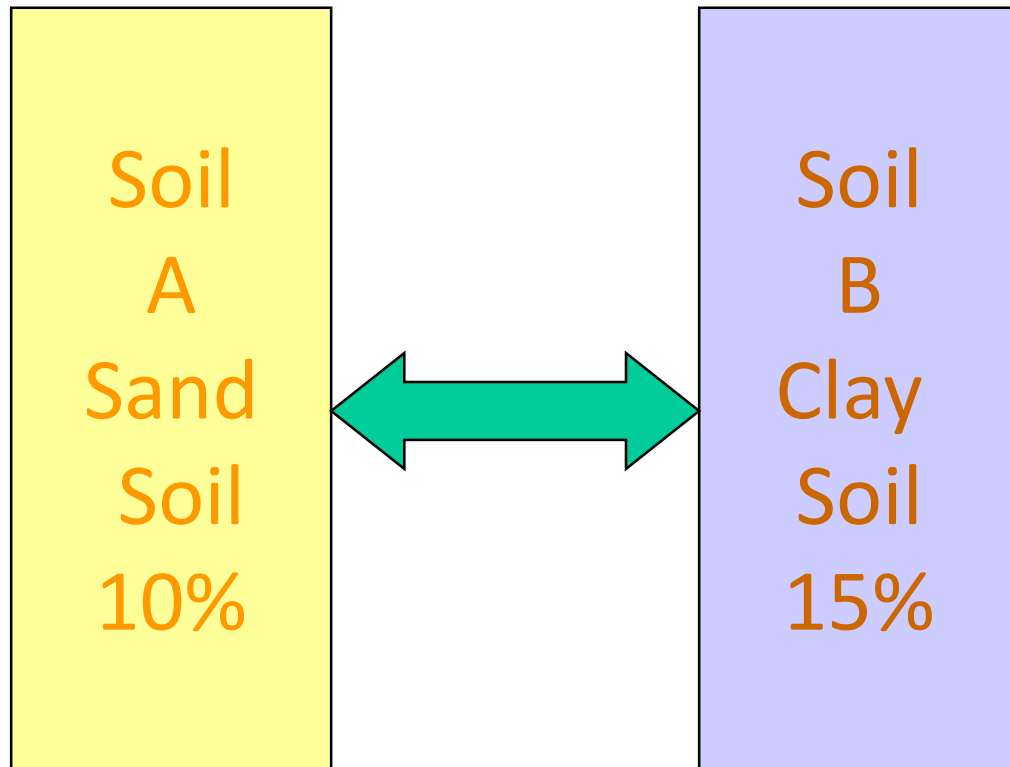
Water moves from areas of high potential to areas of low potential

Total soil water potential:

$$\psi_t = \psi_m + \psi_s + \psi_g$$

Cover Design – Hydrology – Soil Water potential

- Saturated soil: moving force is the gradient of a *positive* pressure potential
- Unsaturated: moving force is the direction of a *negative* matric potential

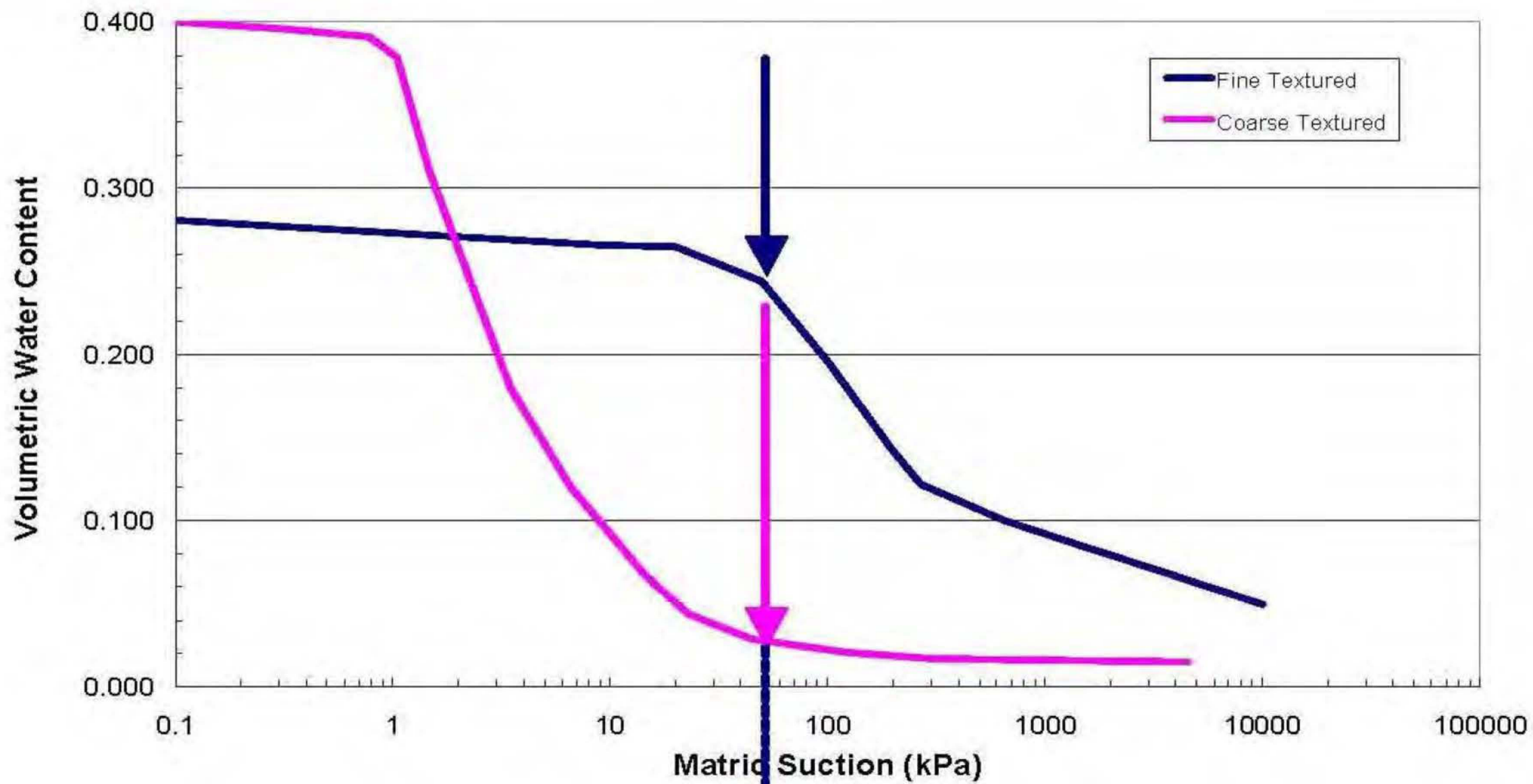


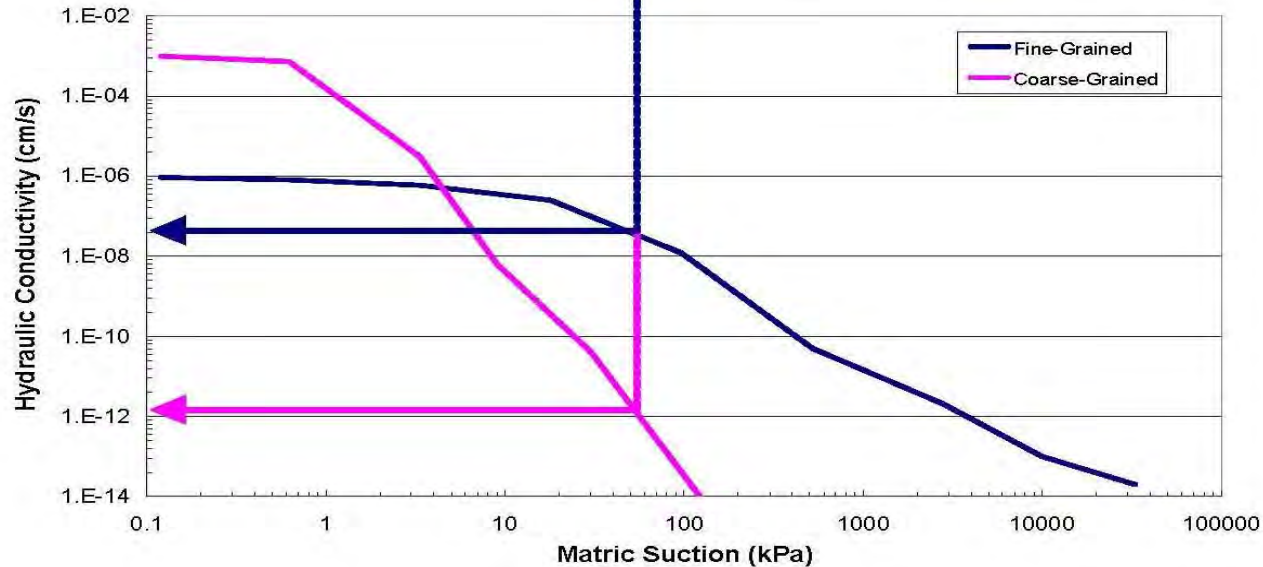
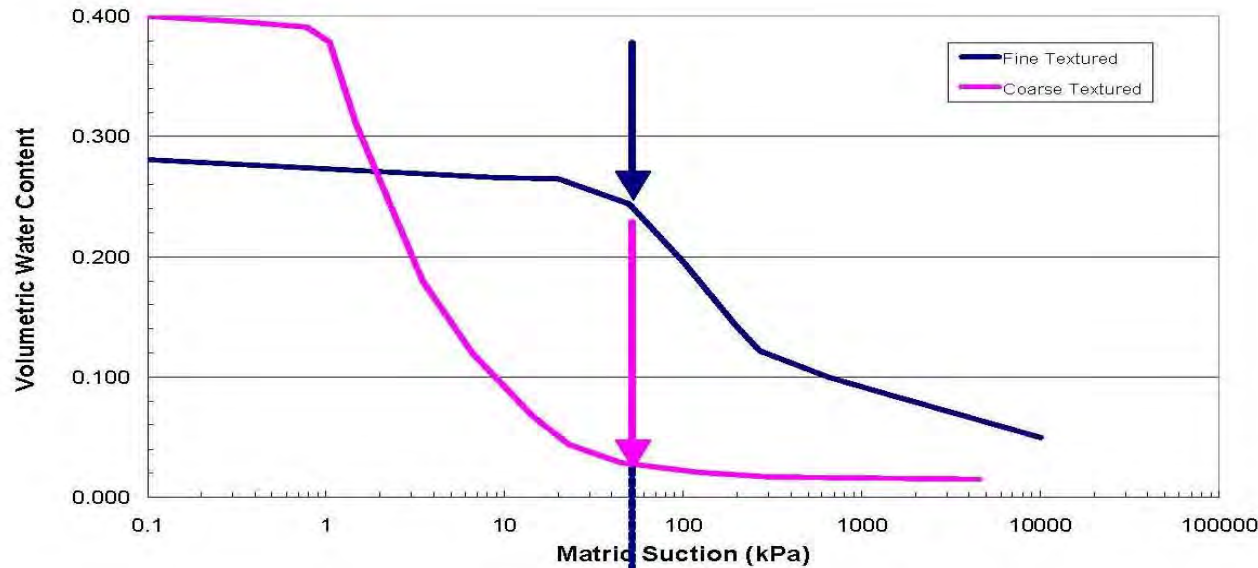
Soil Water Characteristic Curves

The relationship between matric potential or pressure head and volumetric water content for a particular soil is known as a **soil water characteristic curve**

The shape of soil water characteristic curves reflect the distribution of pore sizes in the soil - which is in turn controlled by grain-size distribution and sorting.

This is the single most important relationship to characterize to evaluate whether or not a soil can be expected to reasonably achieve a performance goal on a soil cover system.



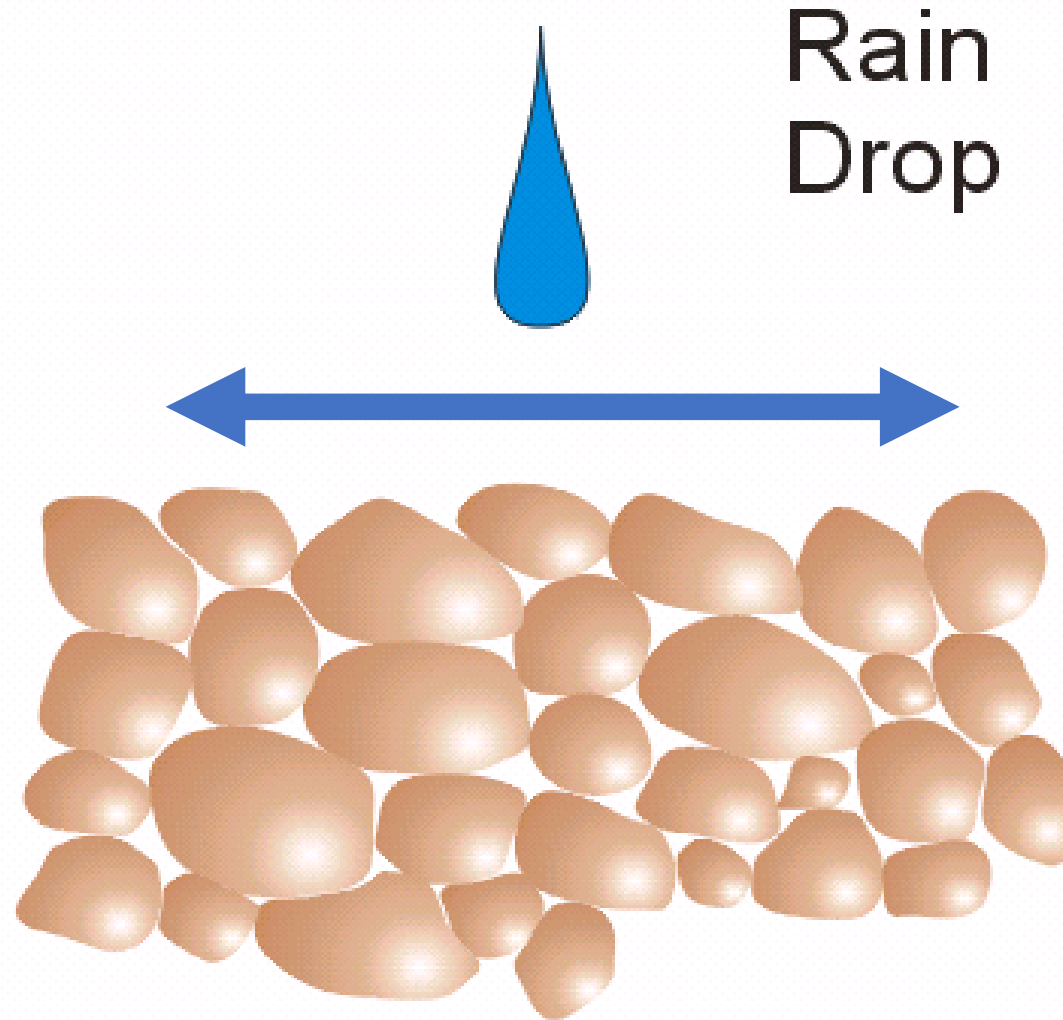


Unsaturated Hydraulic Conductivity

- Unsaturated soils have a lower hydraulic conductivity because some of the pore space is filled with air and thus cannot transmit water
- Soil moisture in the unsaturated zone travels through only the wetted cross section of pore space
- Unsaturated hydraulic conductivity is a function of water content of the soil $K=K(\theta)$

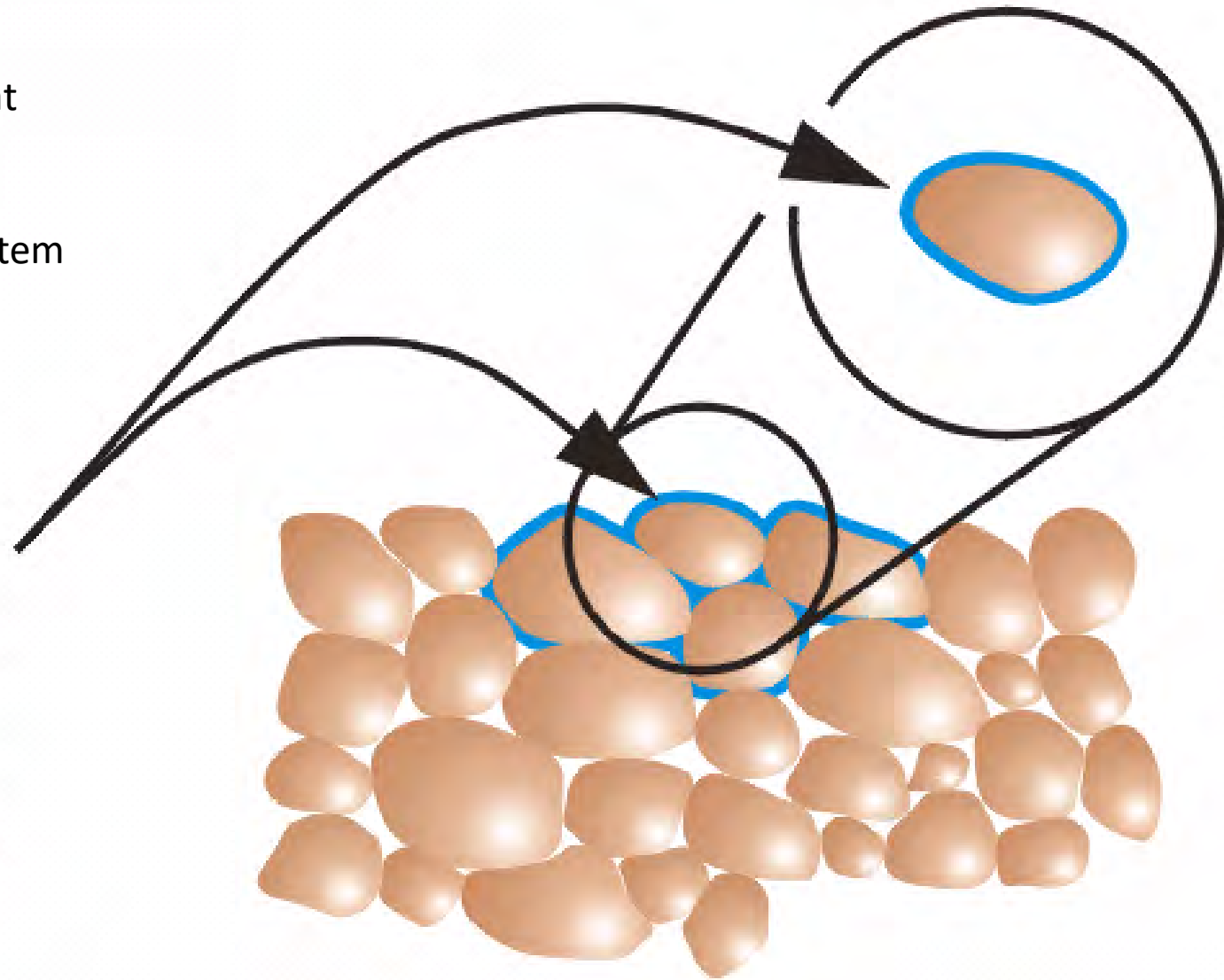
Infinite to zero K
-runoff
-model instability

"Dry"
Surface
Material
(Sand)



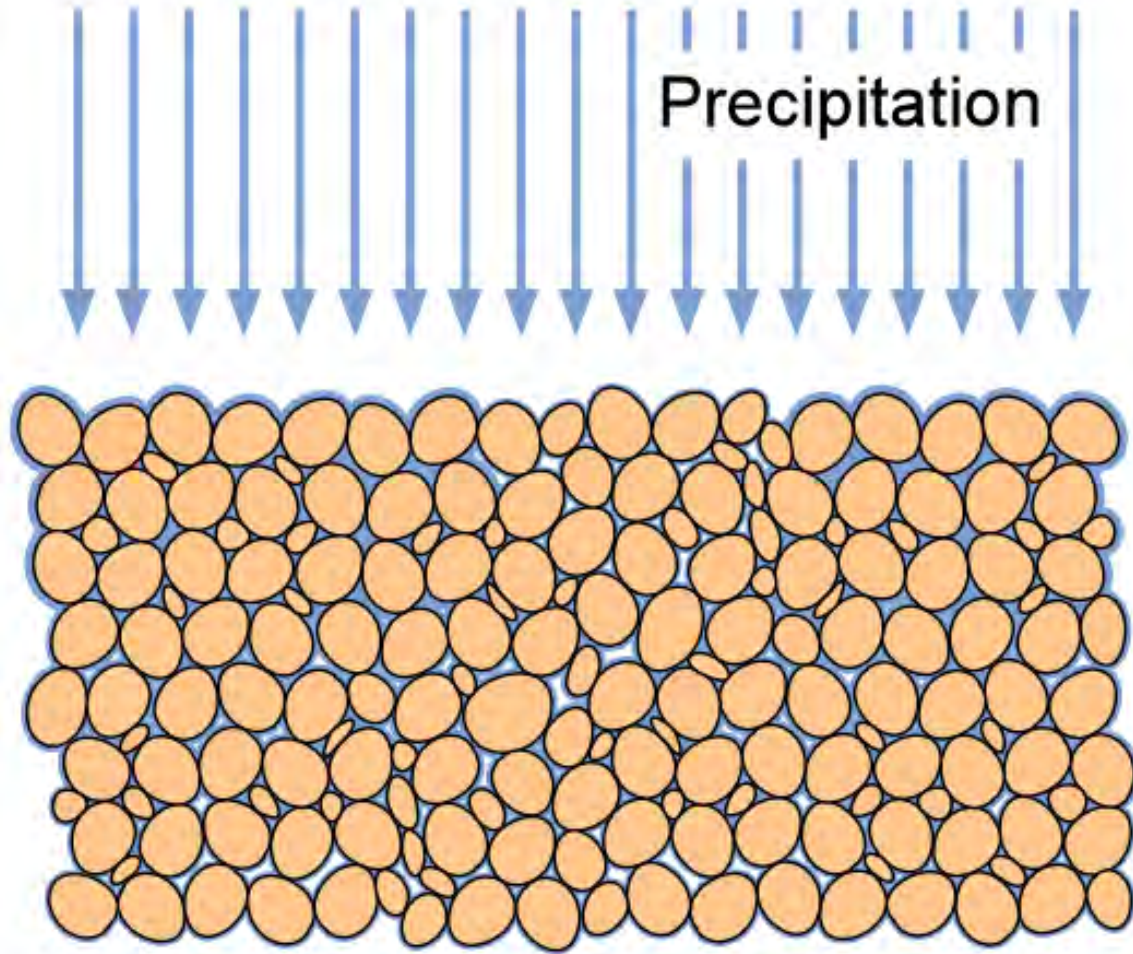
Infiltration capacity > K_{sat}
-less runoff
~non Darcian?
Capillarity dominates system

Water
Adheres
to Grain
Surfaces



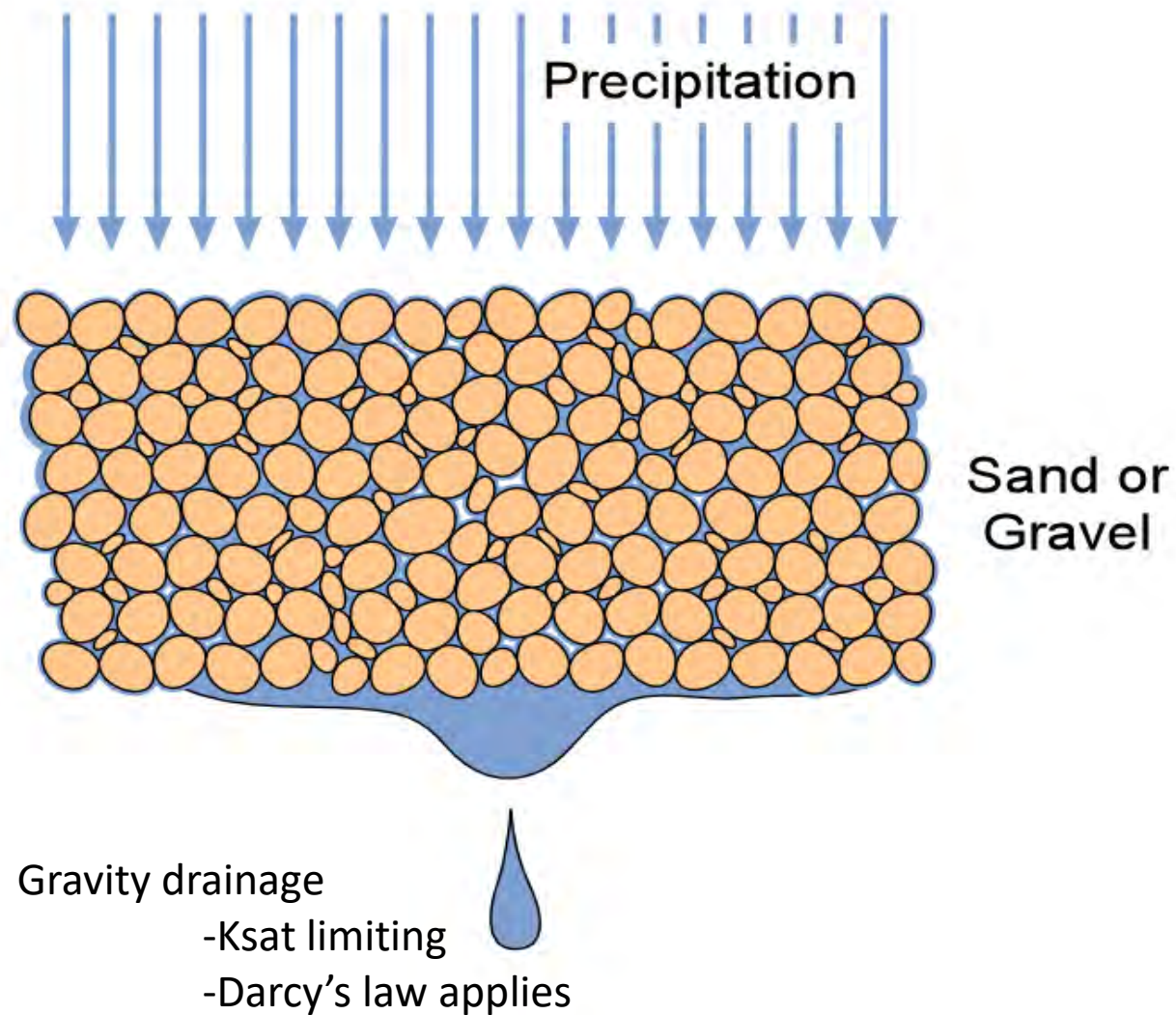
Gravity and capillarity

Precipitation



Sand or
Gravel

Note that water accumulates at, and coats, grain surfaces.



Flow-through occurs when gravity dominates grain boundary forces and surface tension effects.

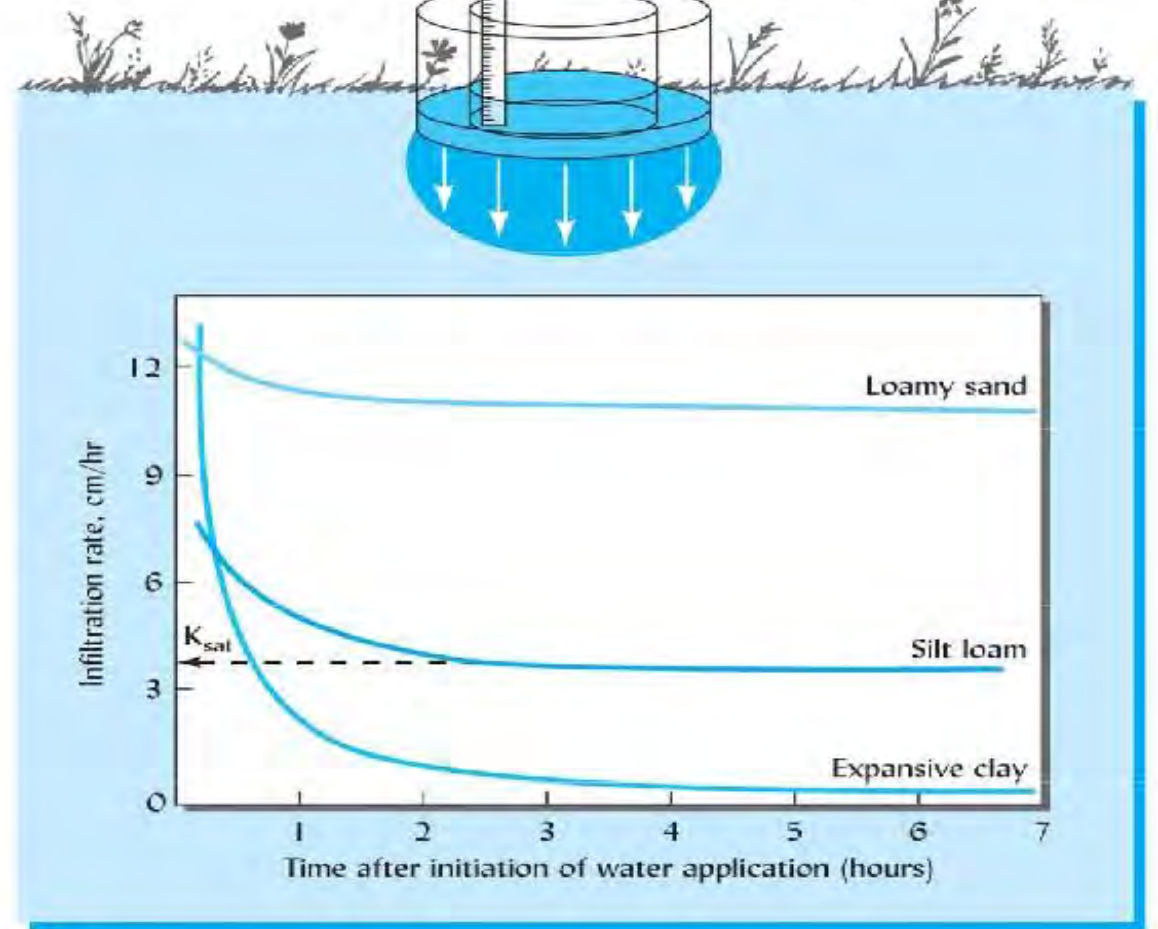
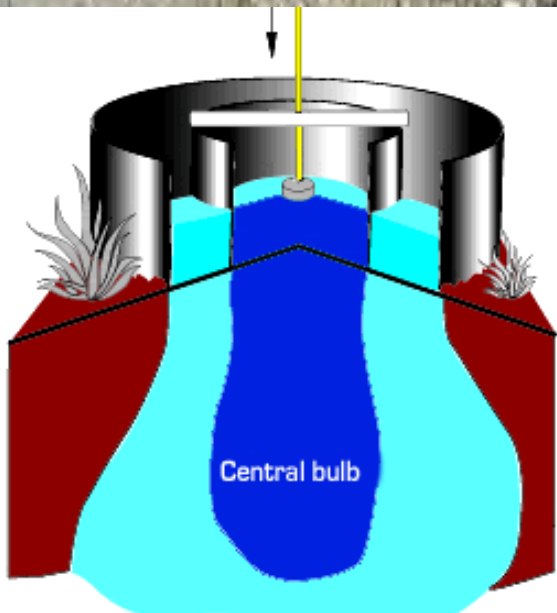
- Will seepage occur if the field capacity of the soil or waste material is not exceeded?

This is where it gets interesting!

Performance Monitoring

8.4.2000





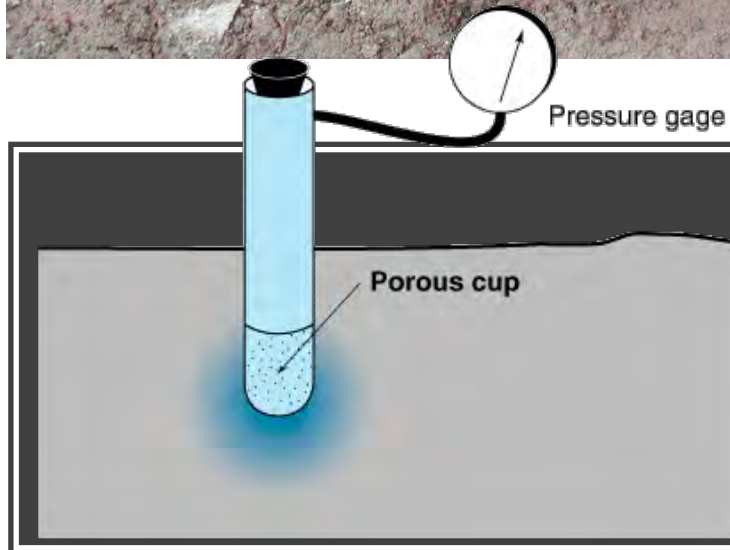
Single or Double ring Infiltrometers

Measuring Infiltration Rate



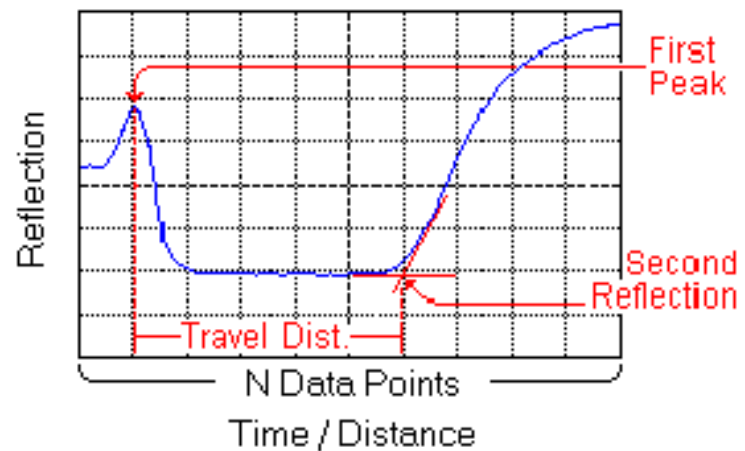
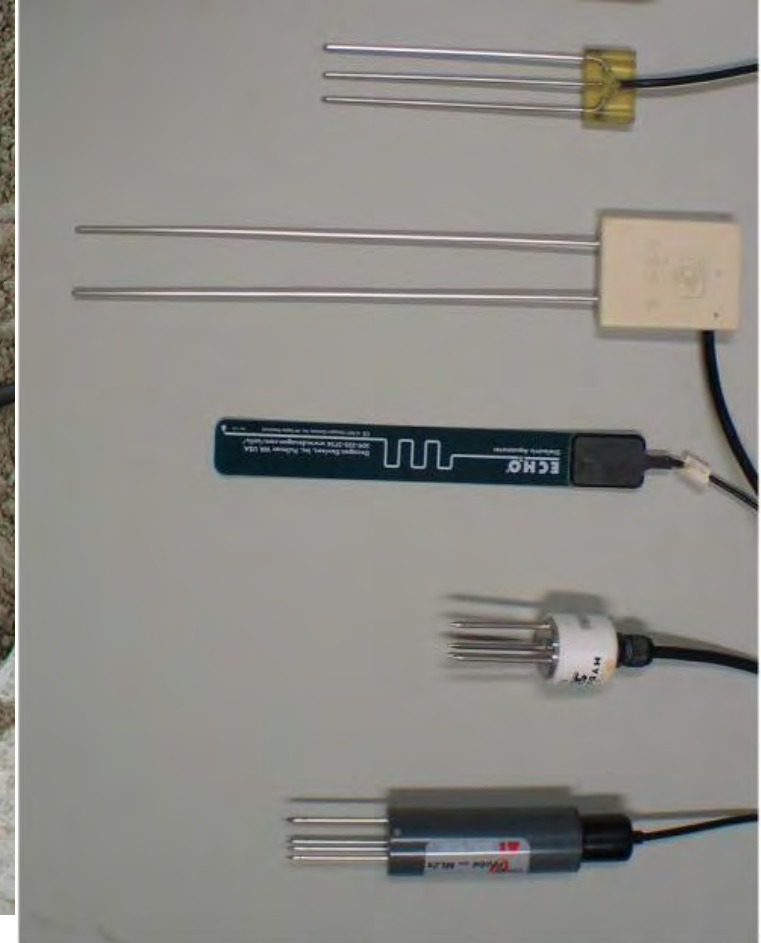
Flooded or Tension Infiltrometers

Measuring Infiltration Rate



Tensiometers

Matrix Suction

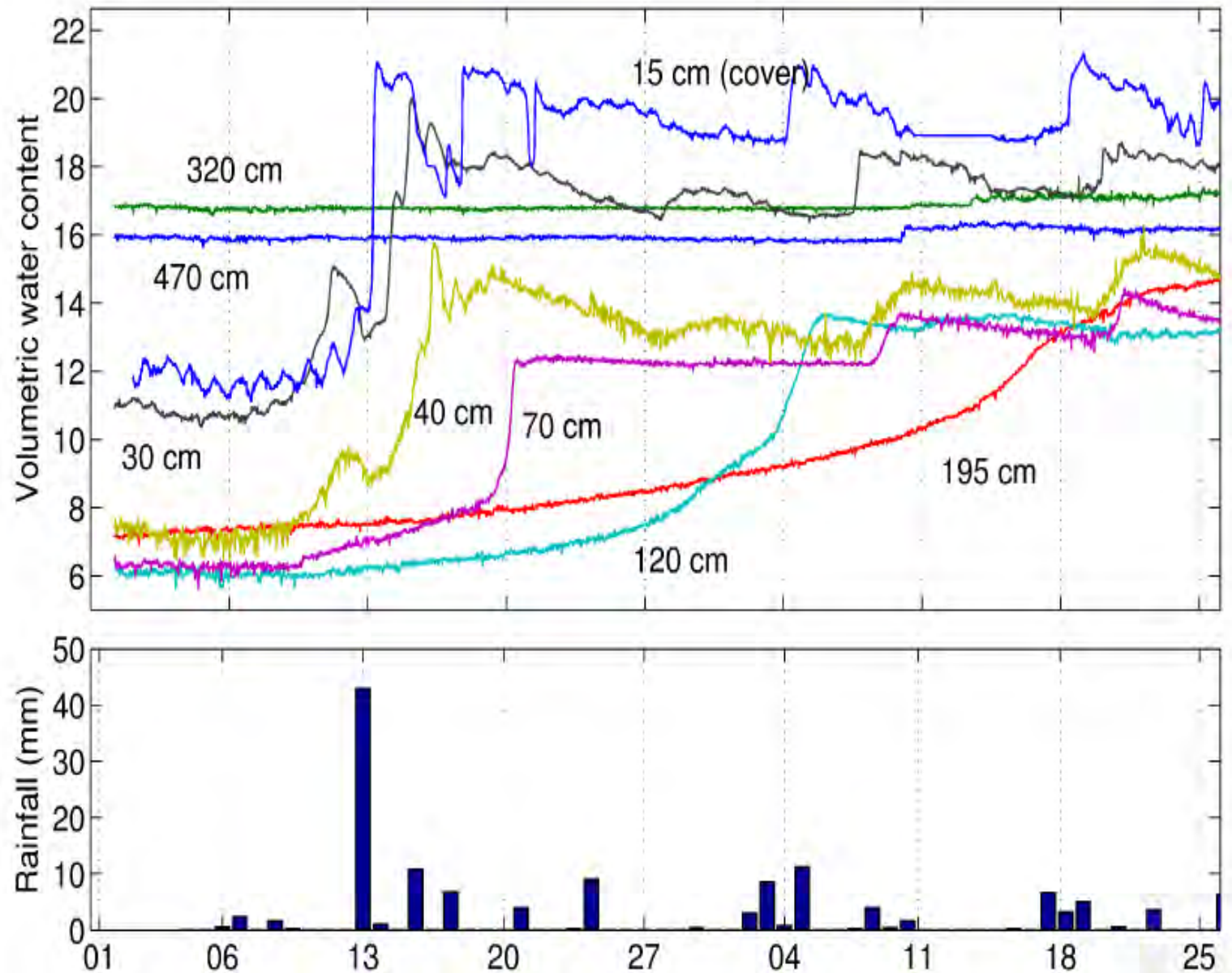


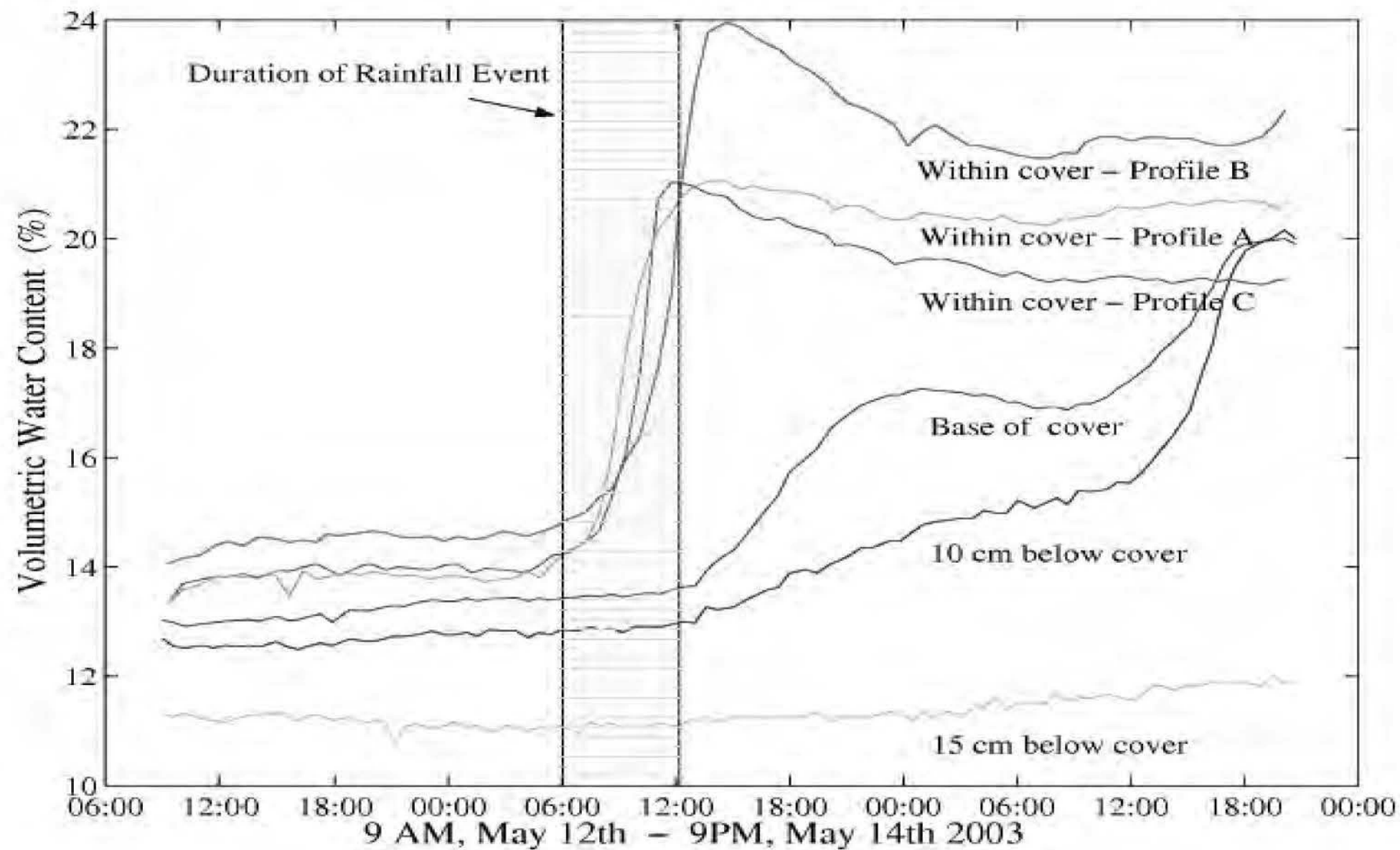
Time Domain Reflectometer

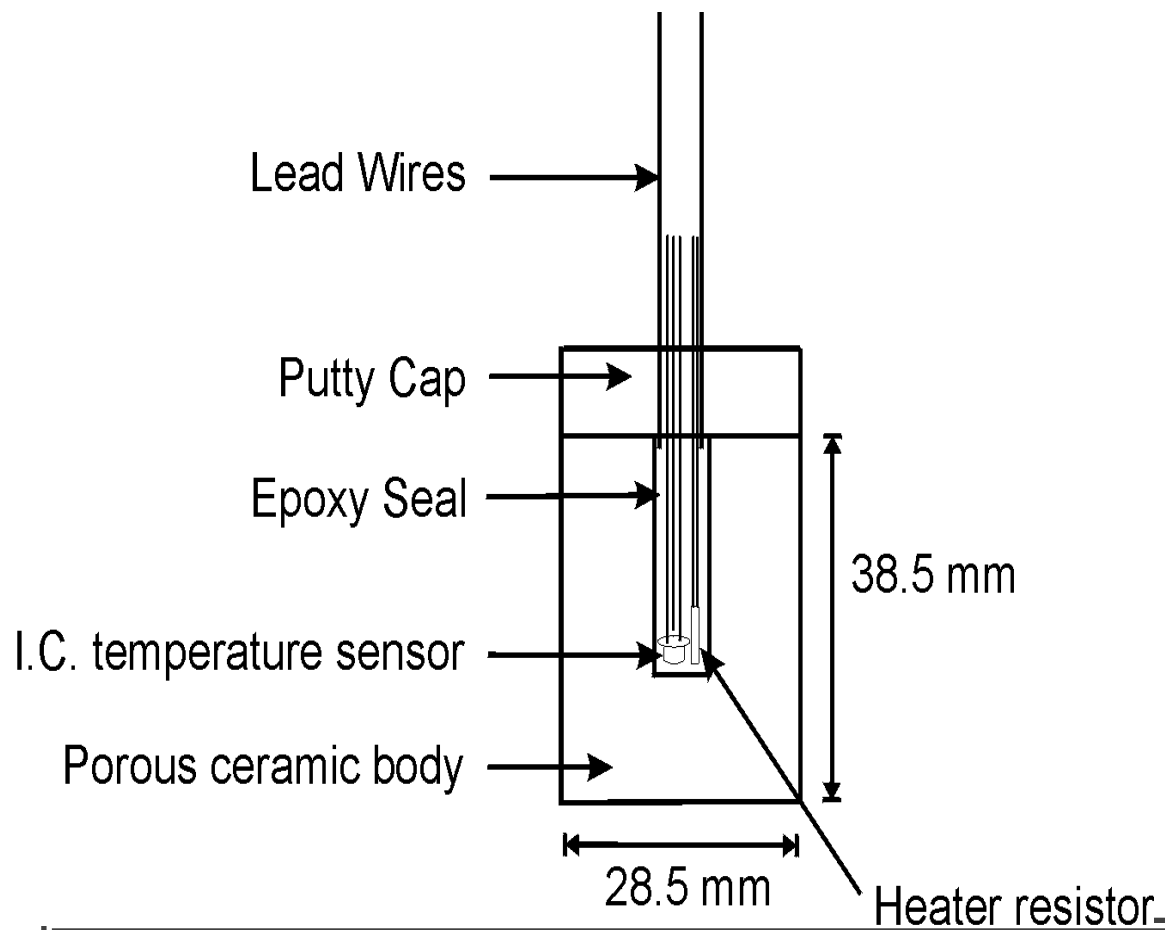
Volumetric Water Content

Data Needs

- Flux calculations based on sensor data
- Collect sensor data at a 4-hr frequency and real-time outflow
- Plot short duration, high resolution hydrographs following storms
- Plot pressure and water content data as depth profiles following storms

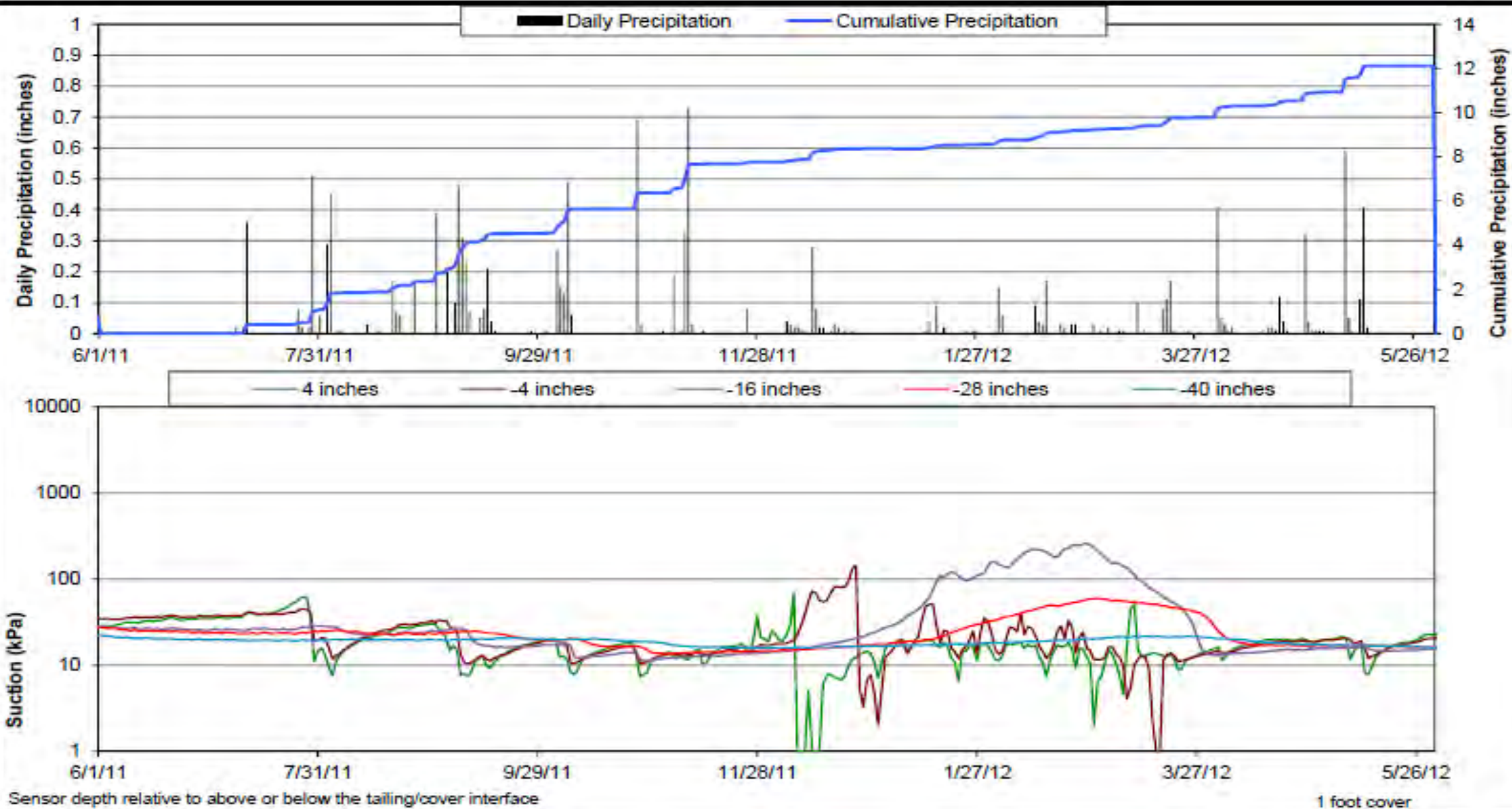






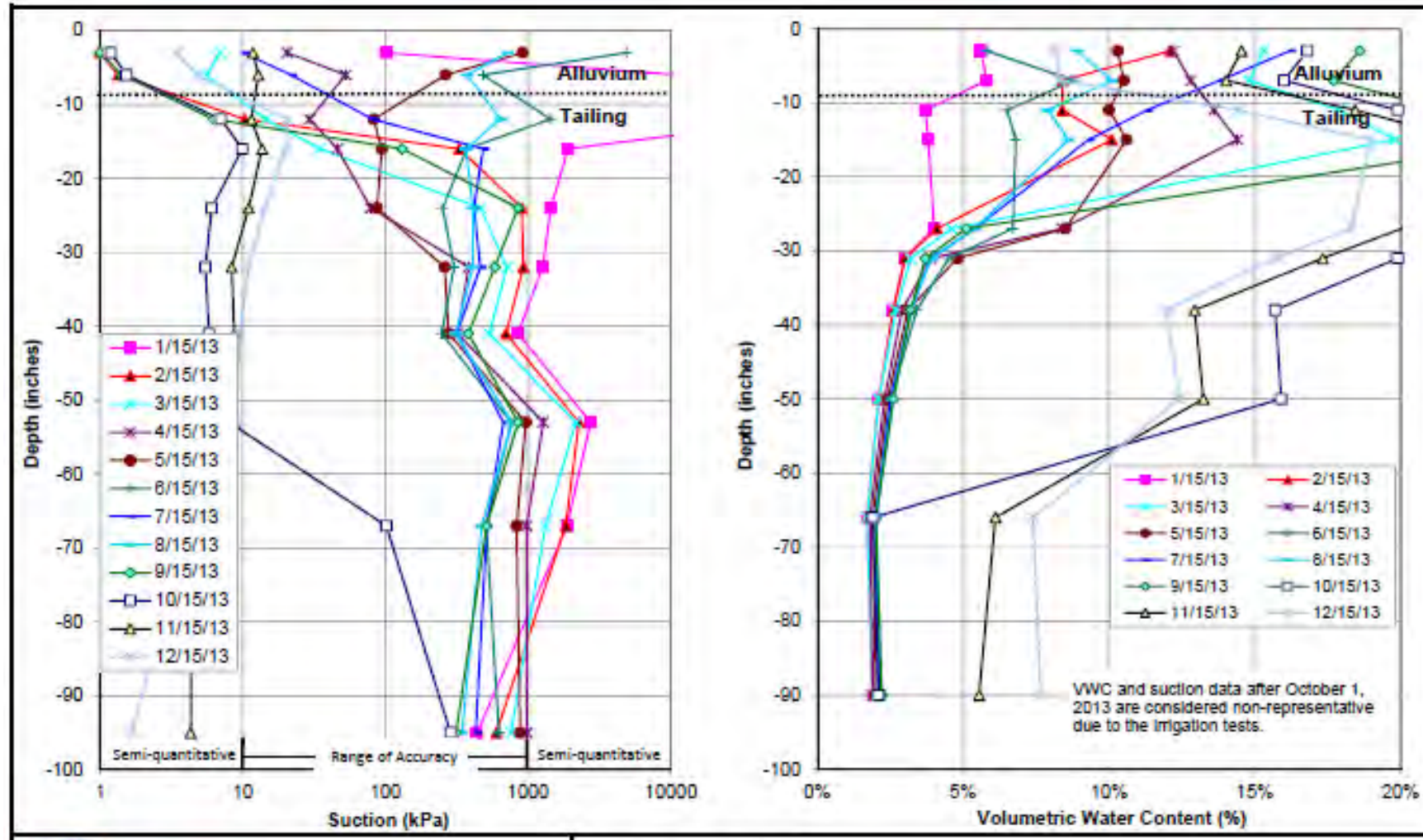
HDS – TC Sensors

Matrix Suction



Matric Suction from HDS

Combine TDR and HDS



- Plot pressure and water content data as depth profiles following storms
- Flux calculations based on sensor data



Lysimeters

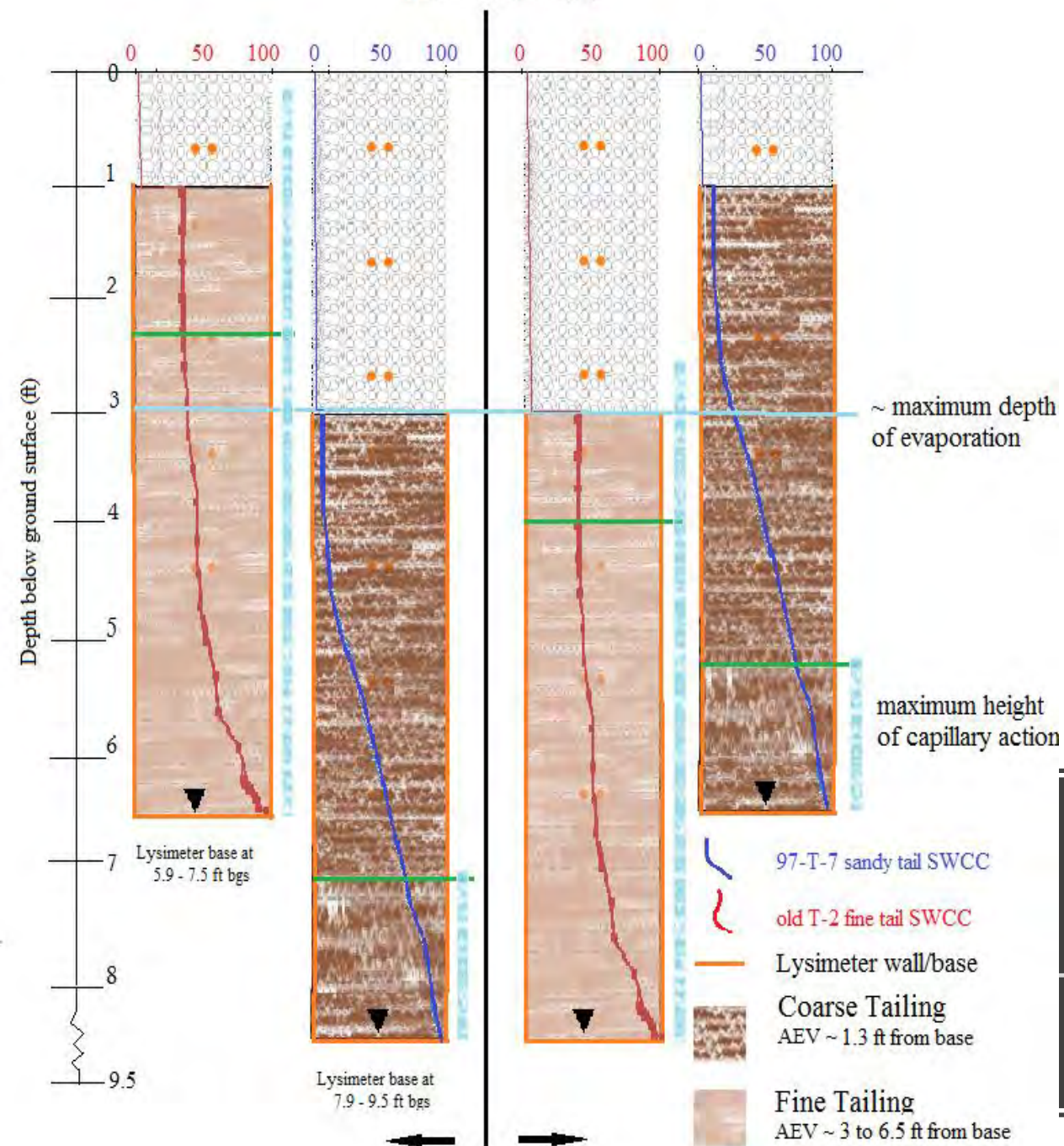
Net-Percolation



Lysimeters

Net-Percolation

Water Content (%)

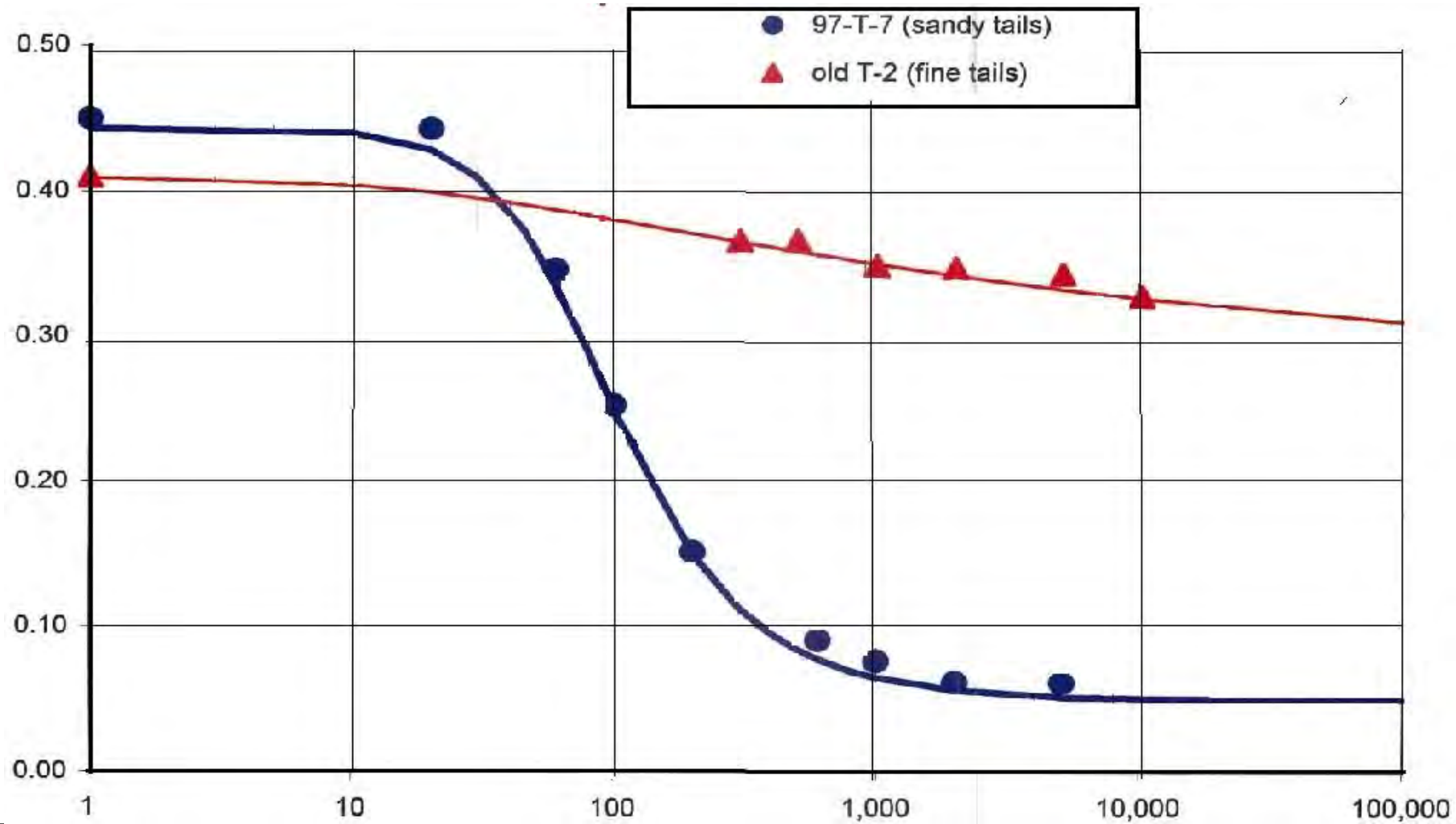


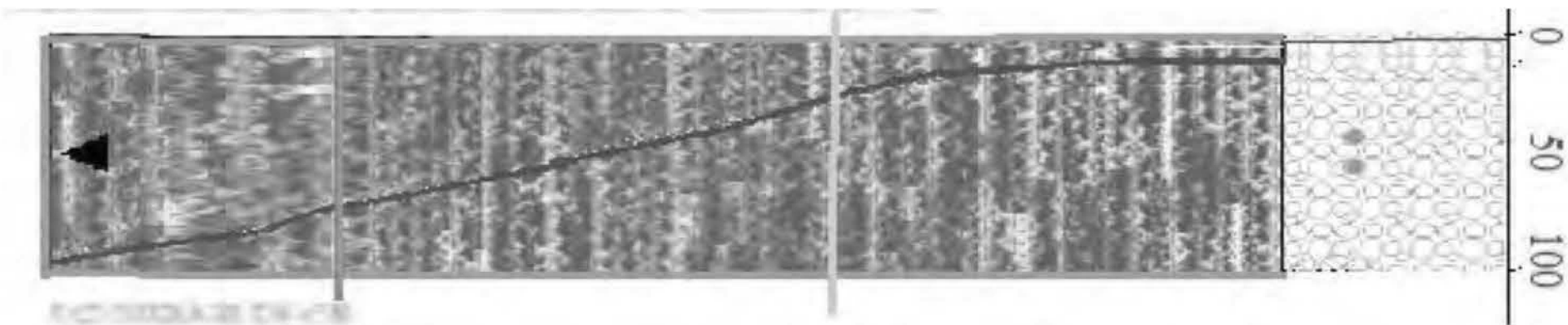
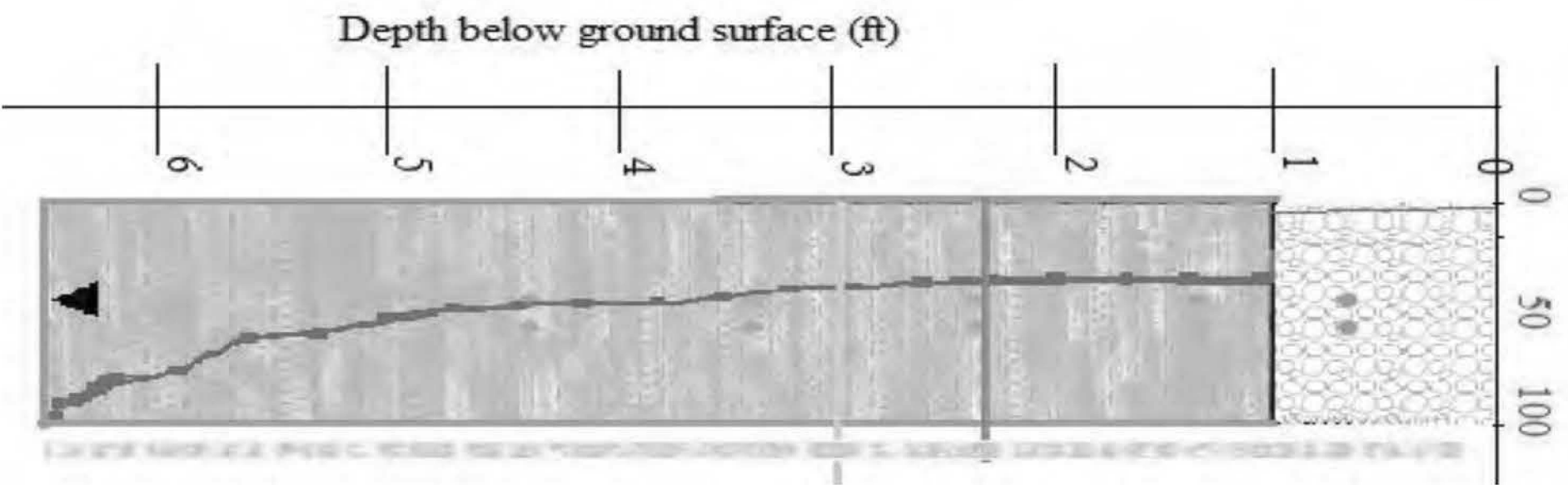
- Free draining: appropriate drainage material based on texture of the waste
- Walls that extend to, or very near the surface: prevent run-on/off and lateral flow
- Lysimeter base deep enough so not to influence the pressure profile at or above the maximum depth of ET

Lysimeter

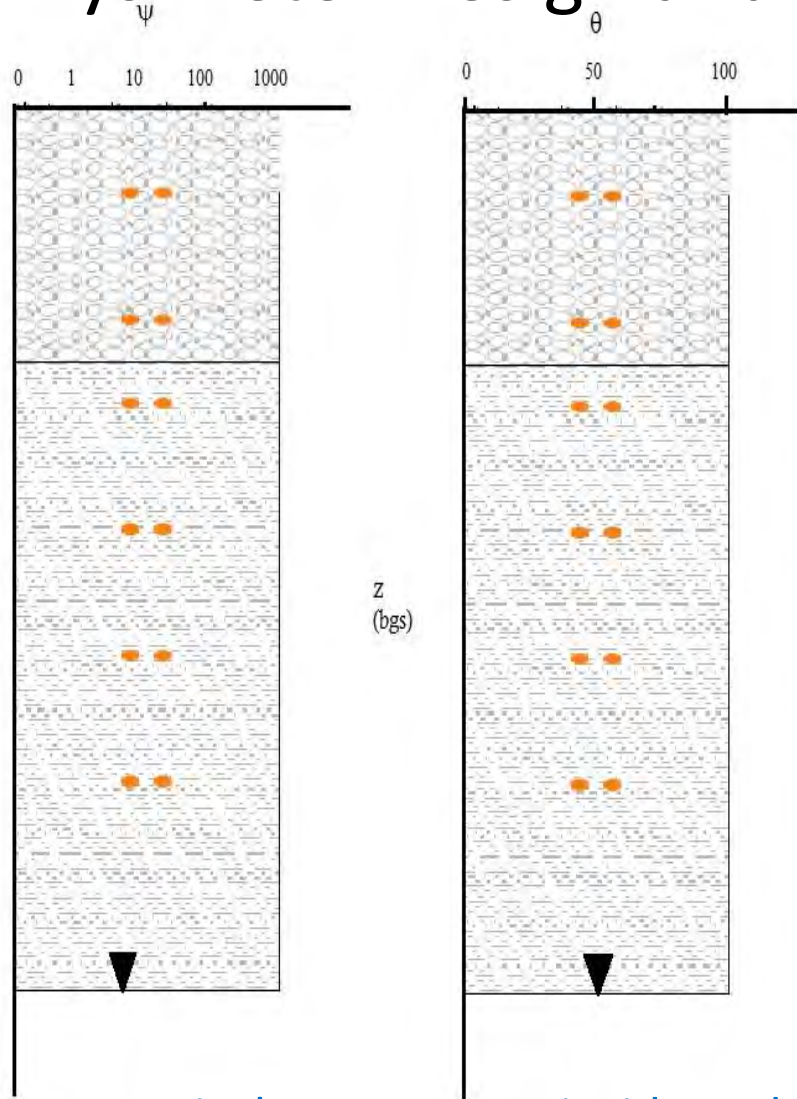
Design and Instrumentation

SWCC's of fine and coarse tailing

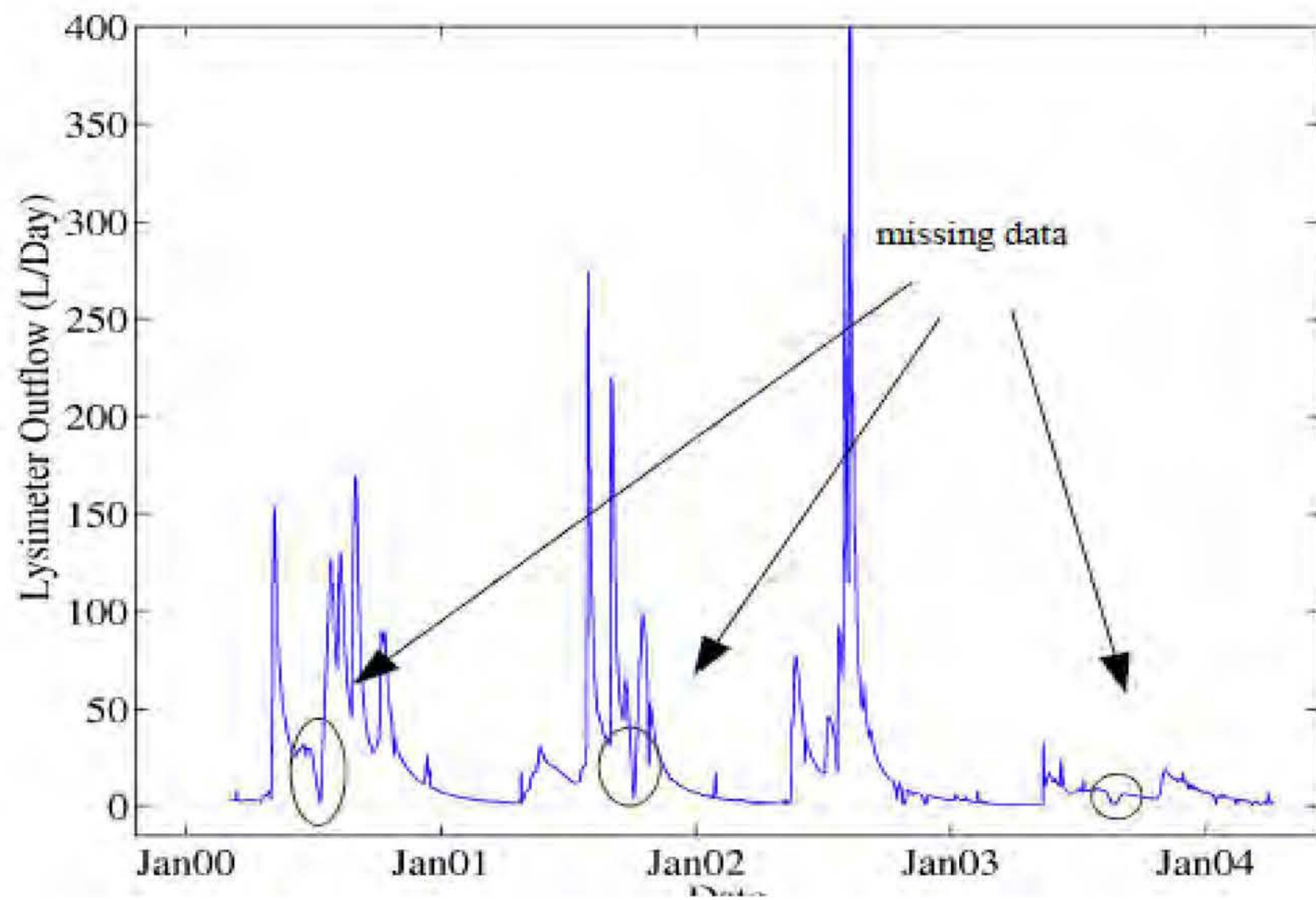


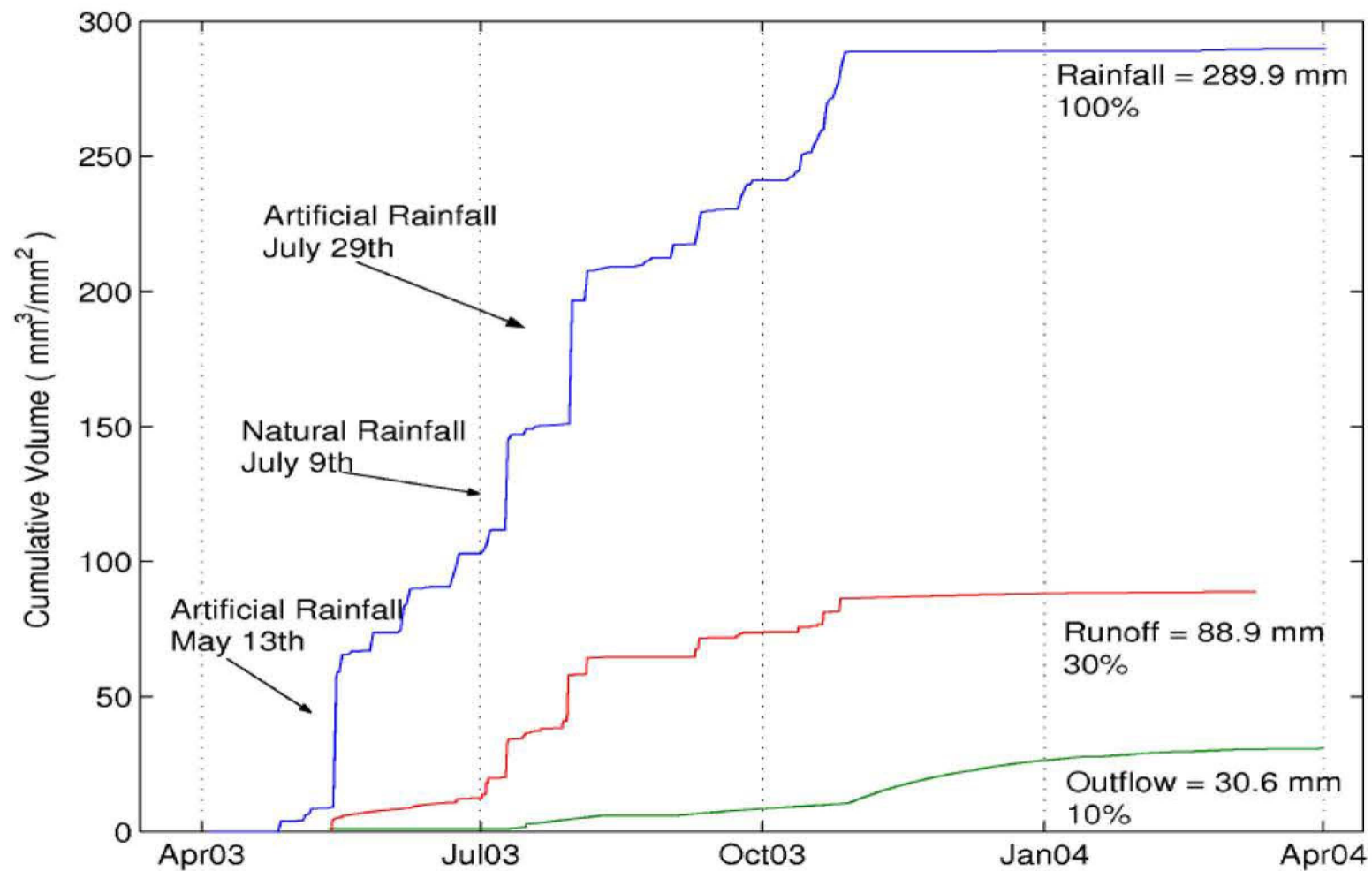


Lysimeter Design and Instrumentation



- Vertical sensor nests inside and outside of each lysimeter
- Sensor nests contain a moisture and a pressure sensor at each depth between cover surface and base of the tailing (lowest nest need not have a TC sensor)





Year	Rainfall	Net-Percolation		AE Calculated		Runoff	
	mm	mm	%	mm	%	mm	%
2000-2001	363	160	44	203	56	0	0
2001-2002	275	145	51	130	49	0	0
2002-2003	316	167	55	149	45	0	0
2003-2004	289	30	10	170	60	89	30

Modeling of performance and prediction

Numerical models are important tools in assessing cover system design and performance; however, the accuracy of unsaturated flow models is limited, primarily by:

- the need for extensive input data, and
- the ability to account for non-Richards or unstable flow phenomenon

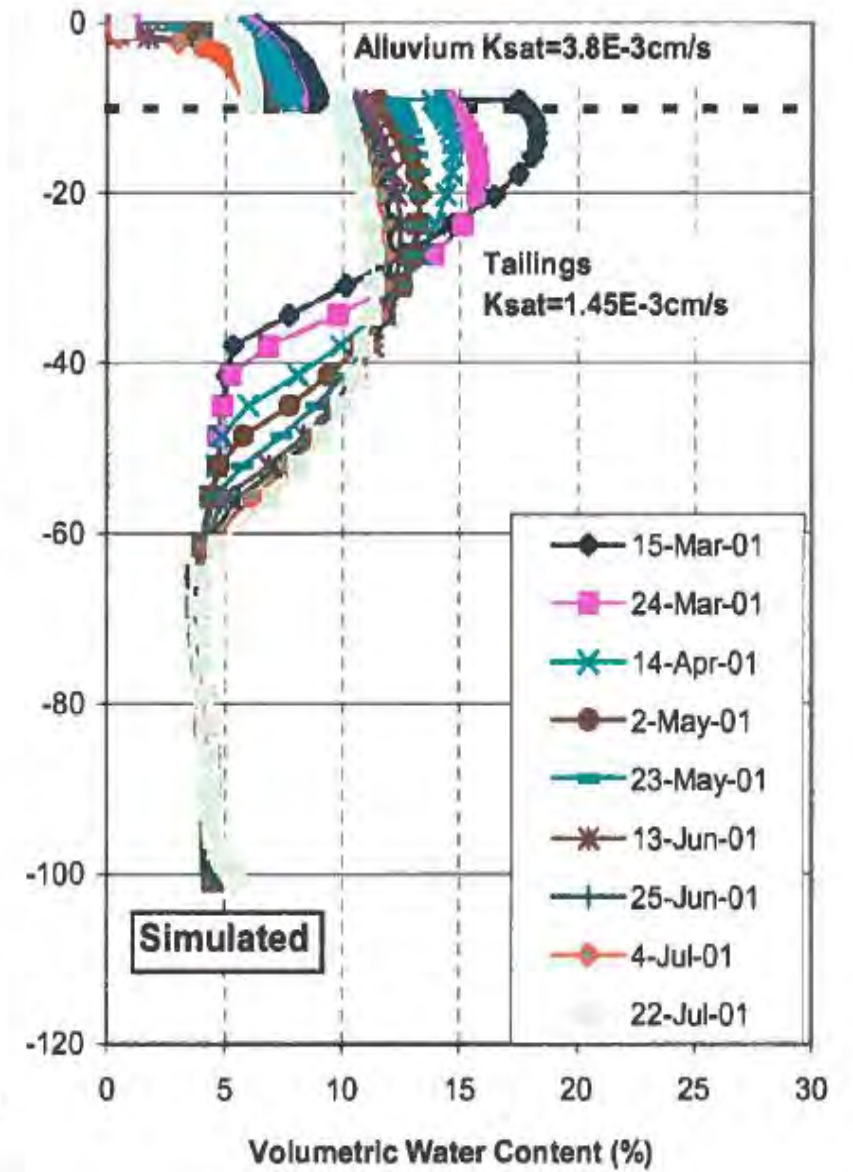
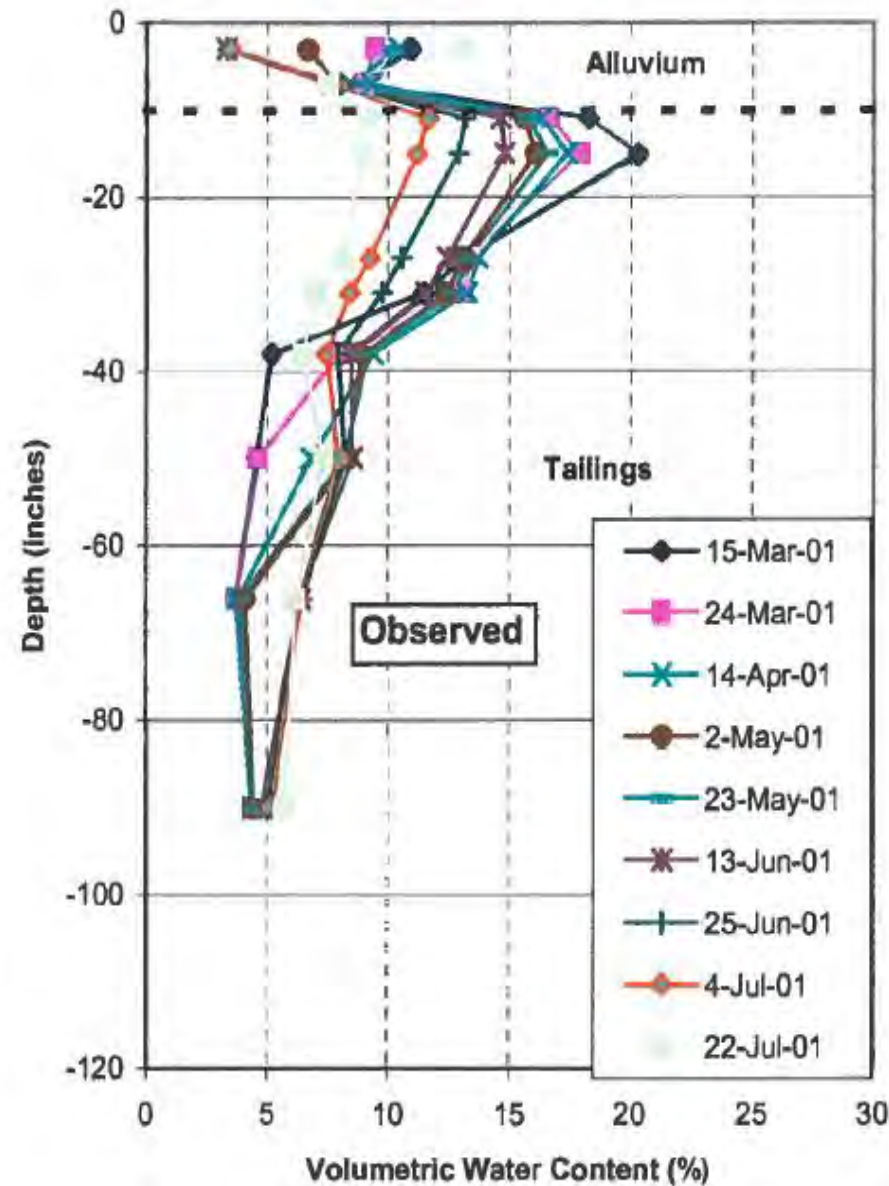
1) Can you calibrate a model to observed field data?

if yes it can be used for prediction and it can be used for further design processes.

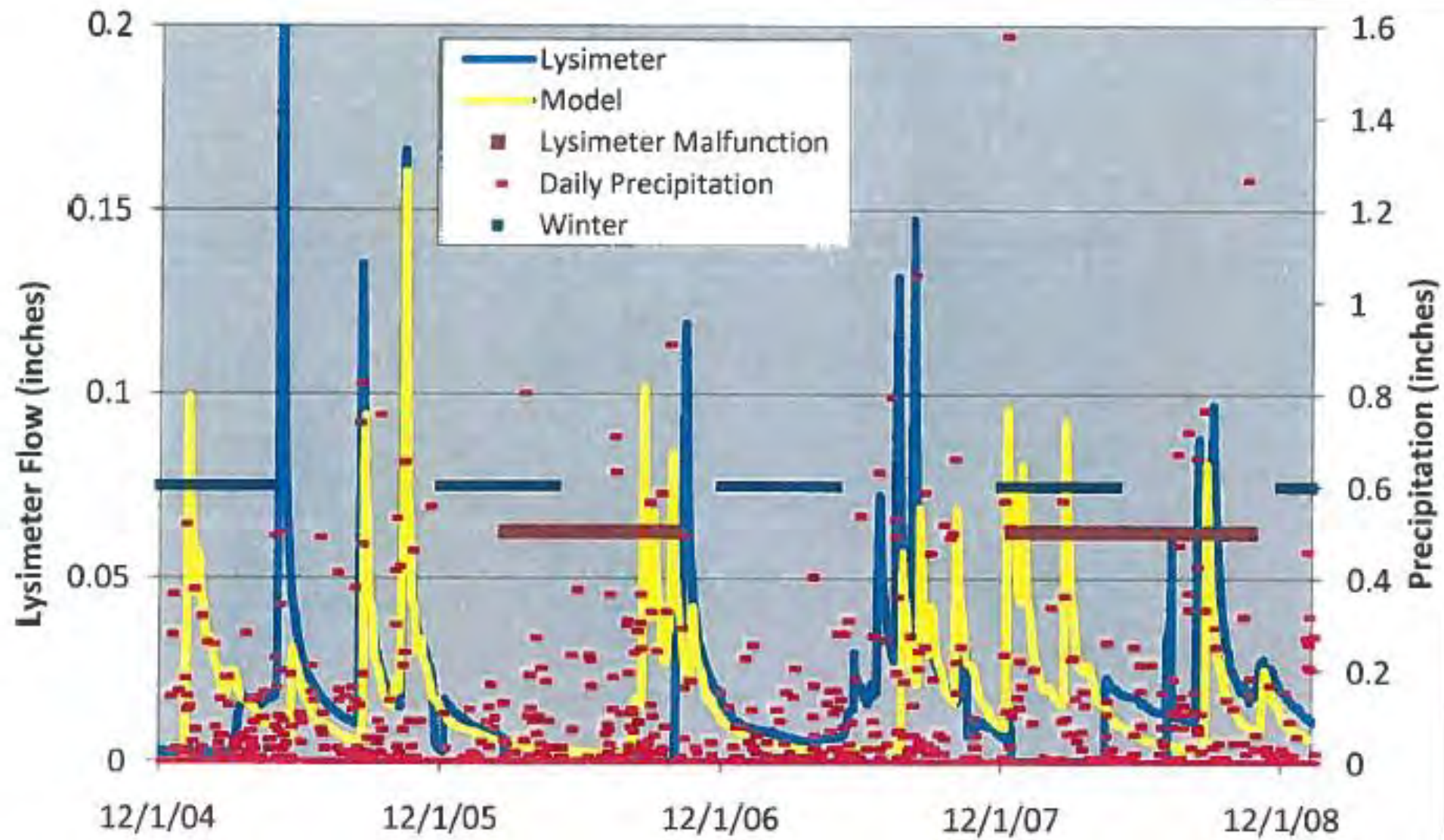
if no, it might be useful for understanding the system but most likely worthless!

Use of a calibrated model with the long-term climate data can provide an estimate of the water balance over a similar period of time.

Modeling



Modeling





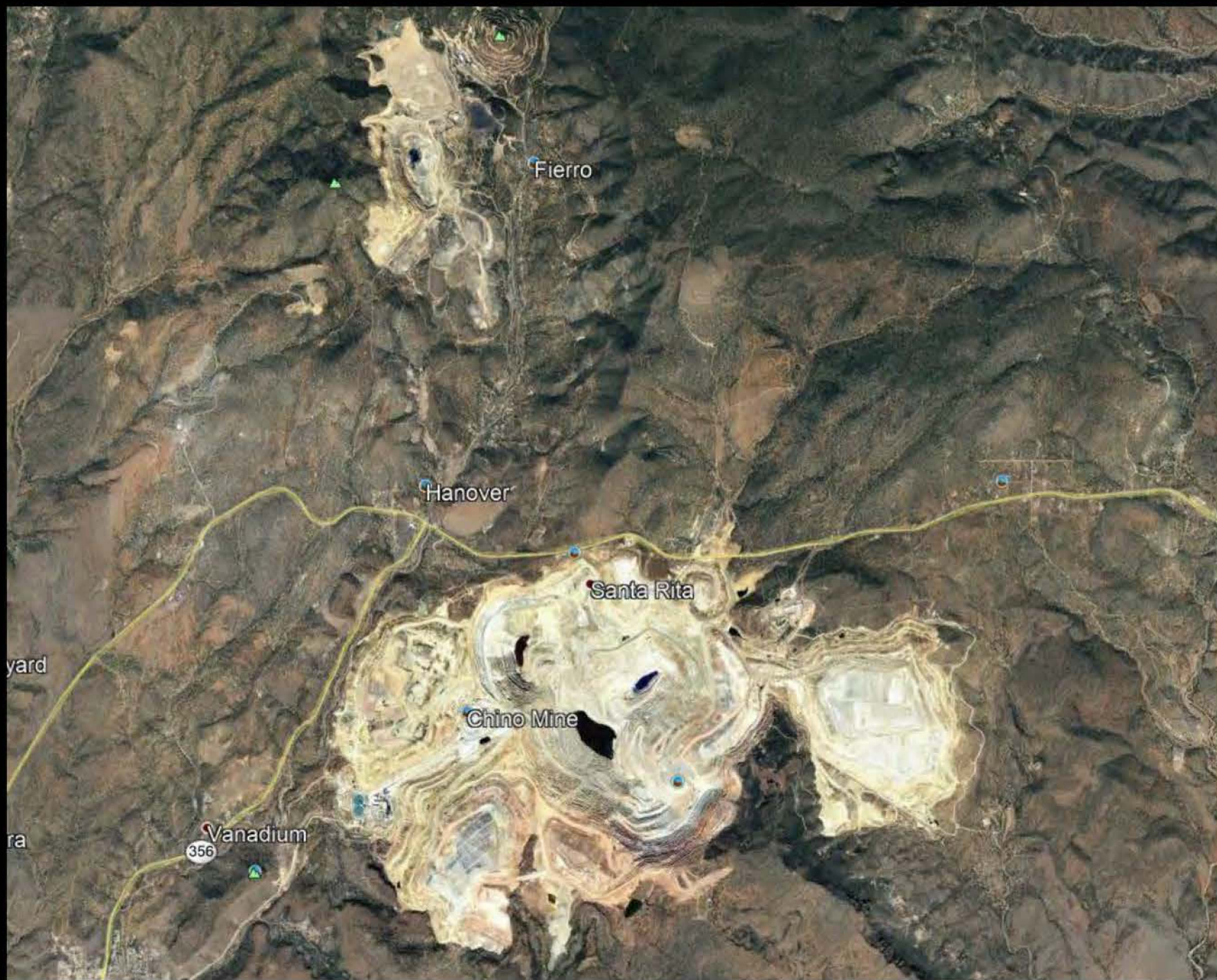


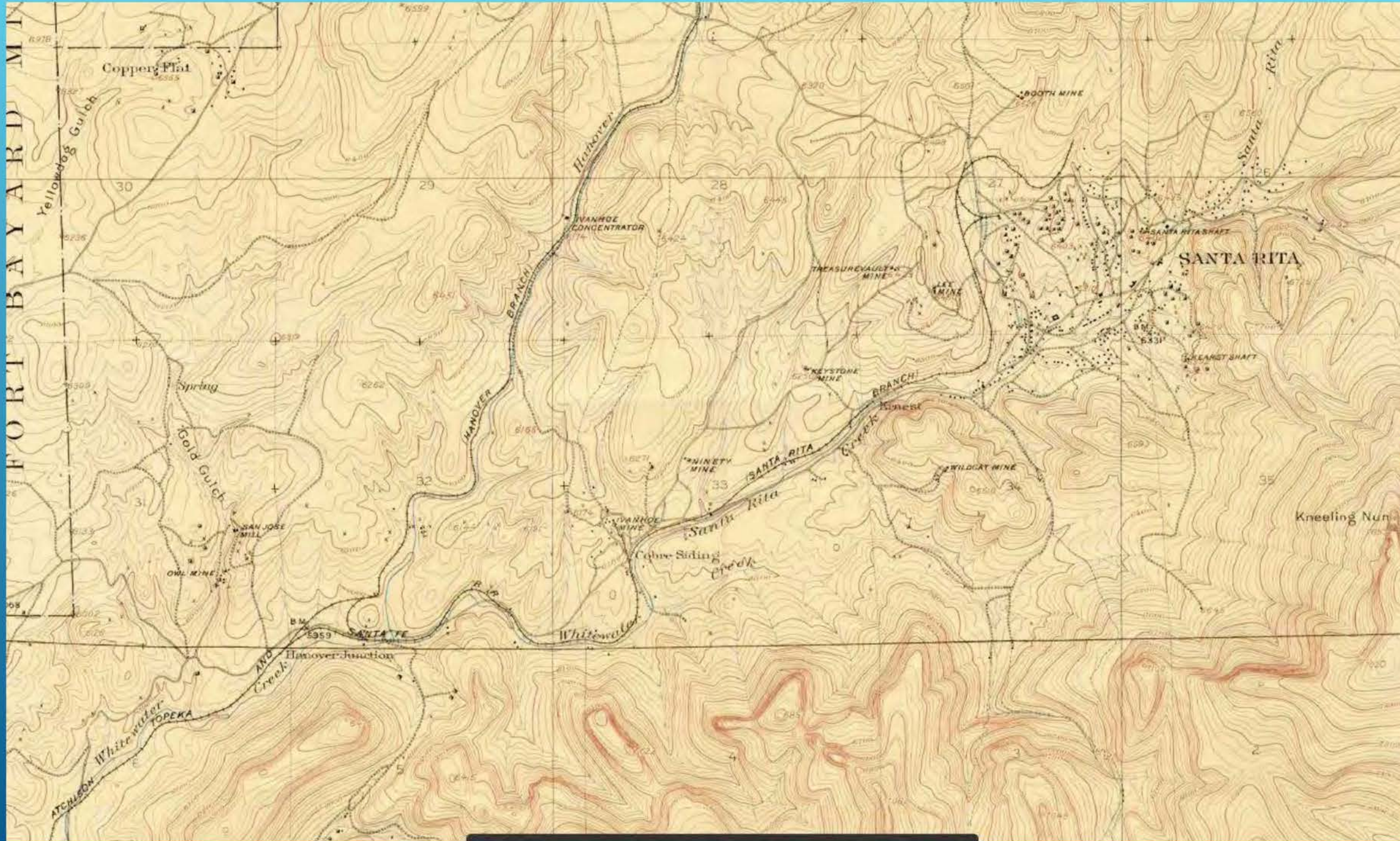


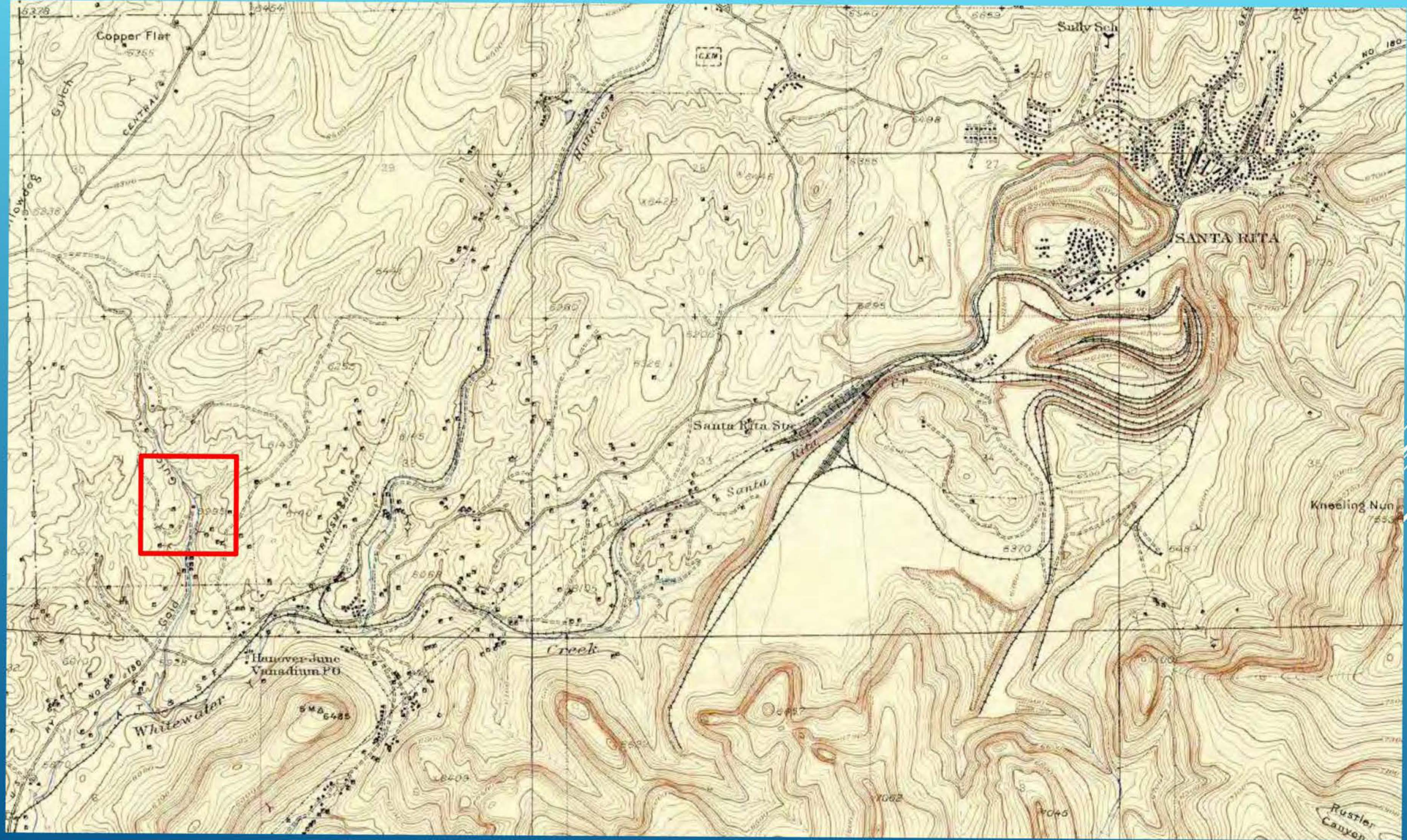


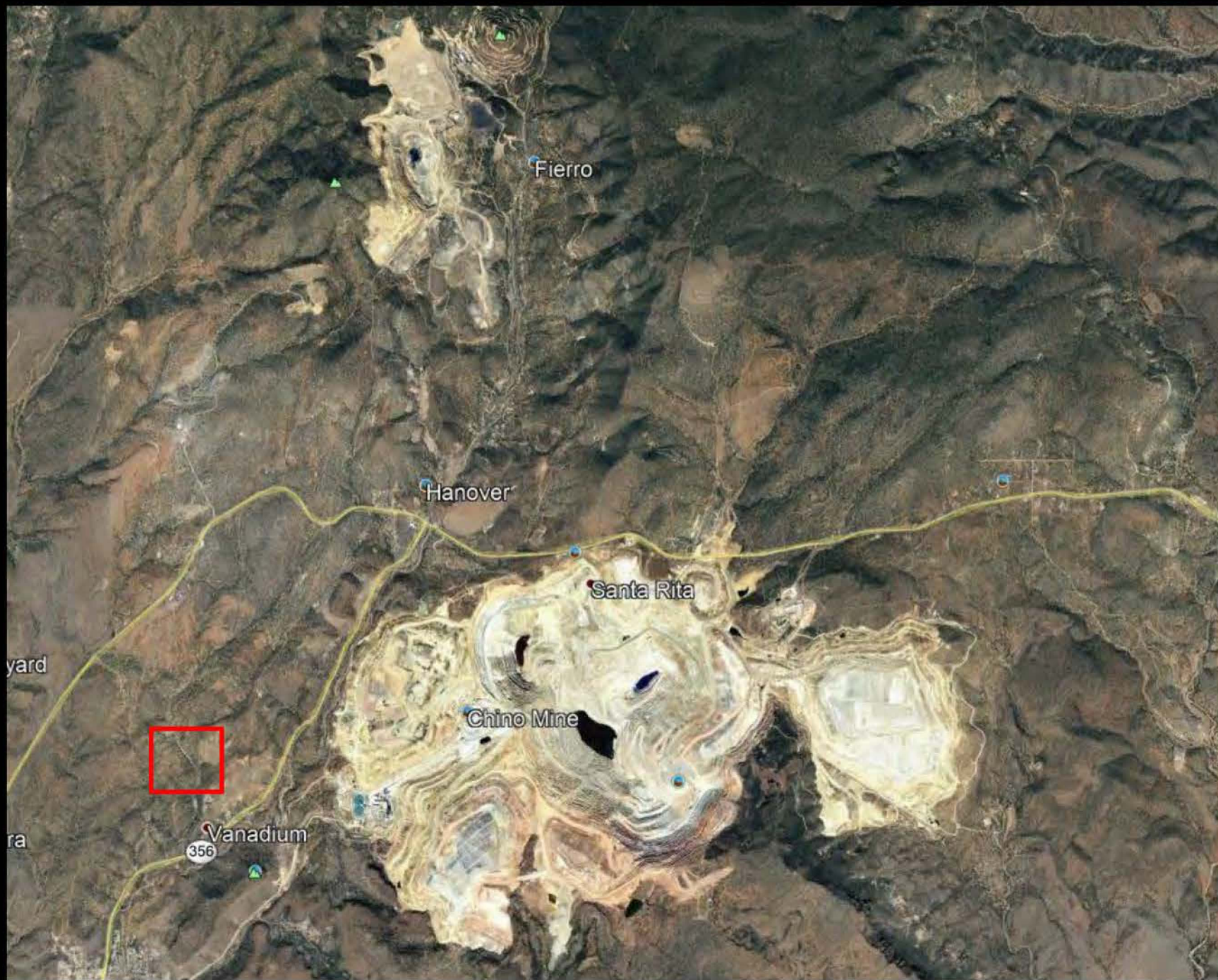
SHAFT BACKFILL

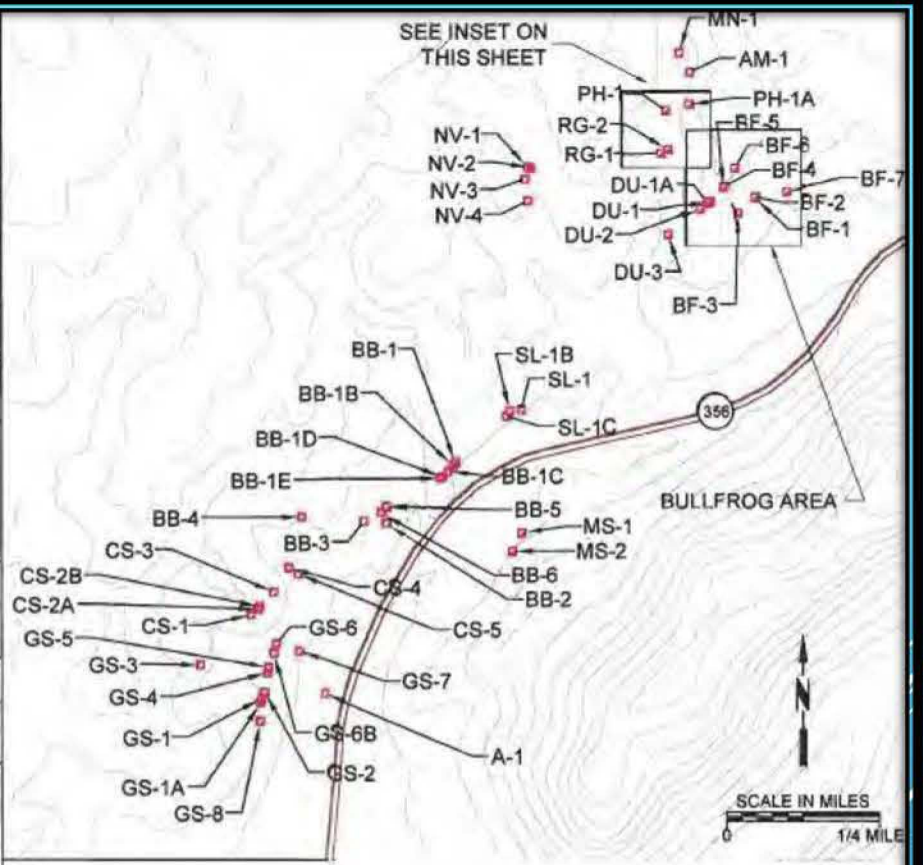
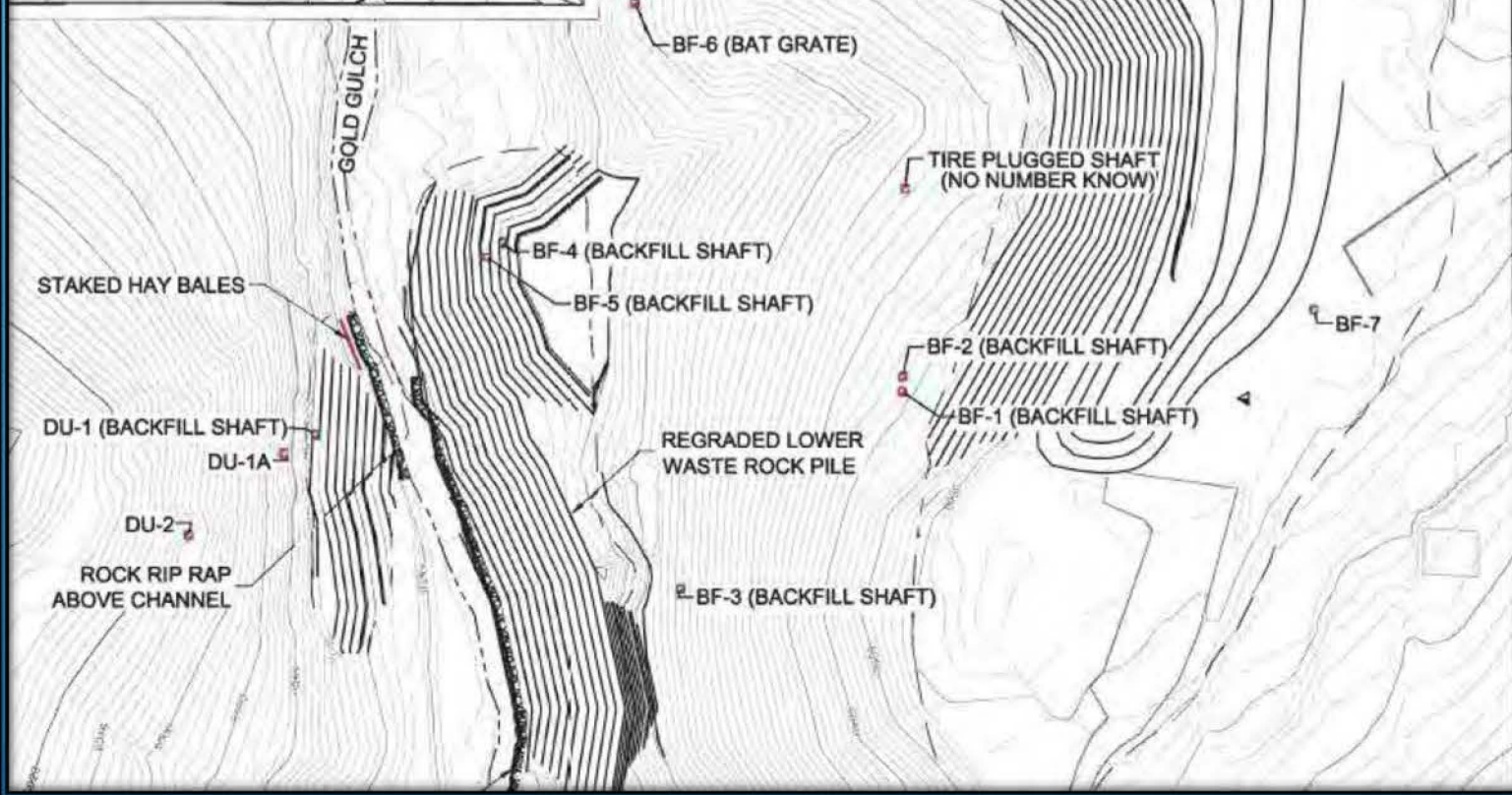
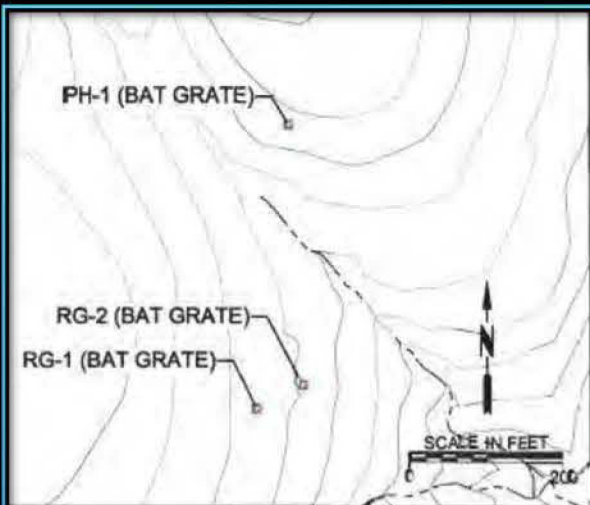
Kurt Vollbrecht, NMED GWQB











LEGEND

STAKED HAY BALES





09/13/2007 15:34



09/13/2007 15:32



09/12/2006 09:01

WHY BACKFILL?

Vertical Waste Repository

- Isolate waste from environment

- Small footprint

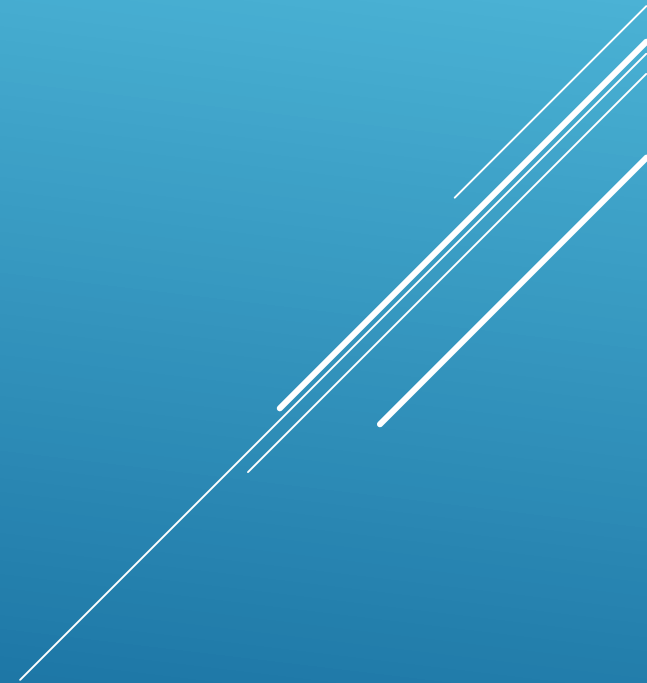
- Minimal long-term maintenance

Short Haul Distance

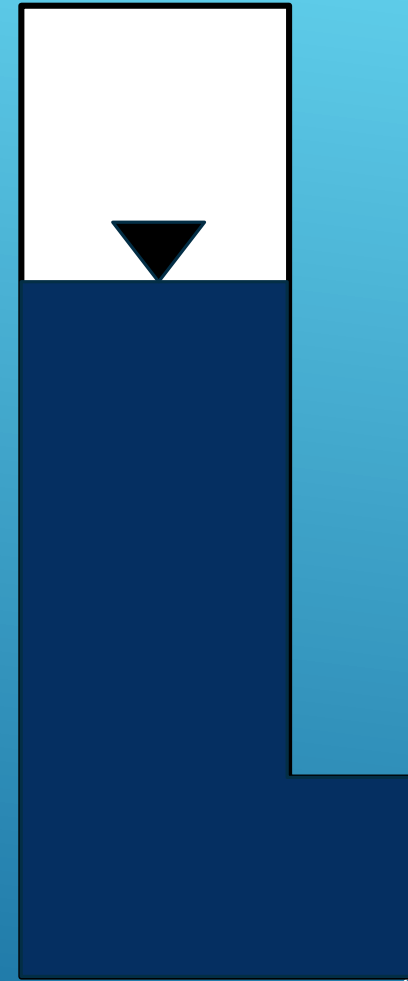
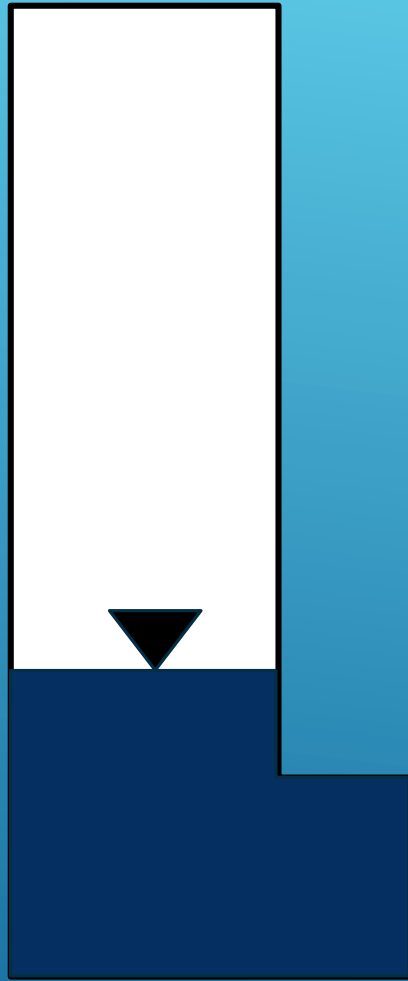
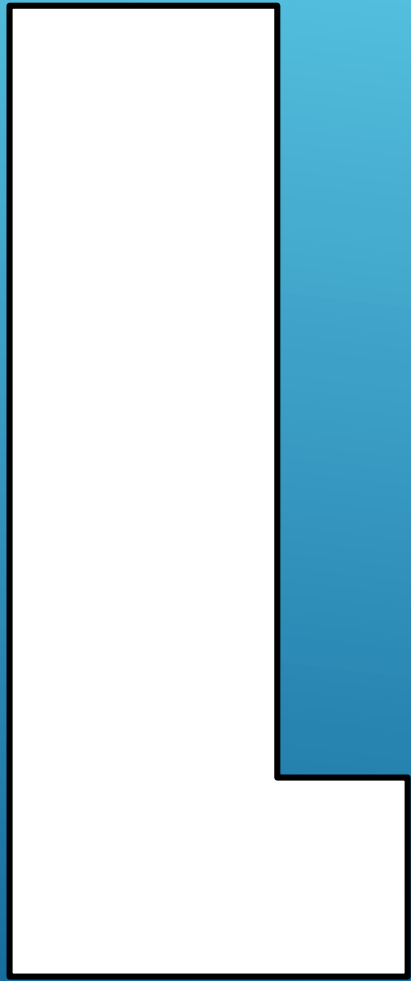
- Minimize impacts to surrounding community

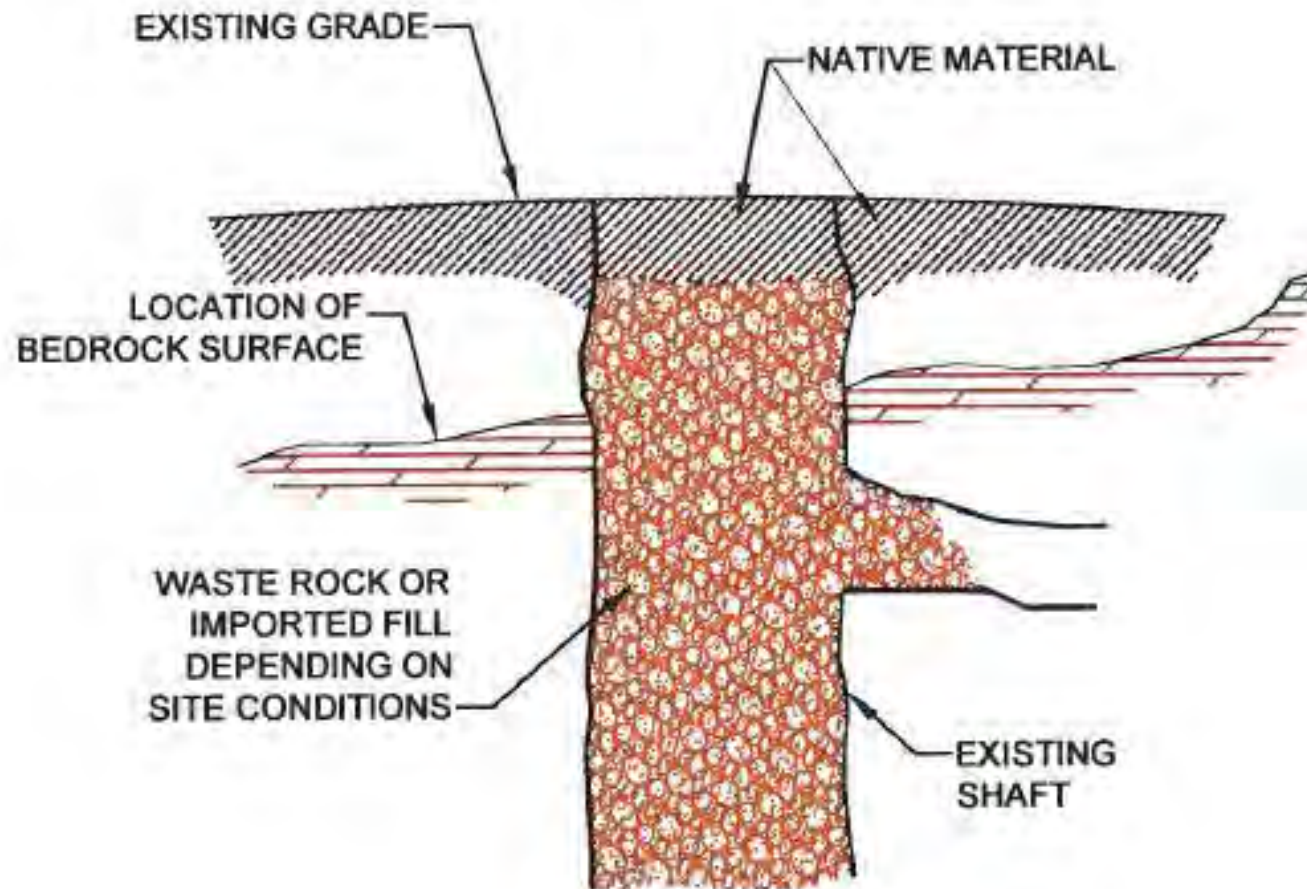
- Cost savings

- Safeguard open mine features



Groundwater present in shaft?





EXAMPLE OF BACKFILLED SHAFT SECTION
NOT TO SCALE

Positive drainage

Mound final cover material

Settlement

Stormwater management



09/12/2006 09:14

QUESTIONS?



GROUP EXERCISE
MINE SITE REMOVAL ALTERNATIVE EVALUATION
Diné Uranium Remediation Advisory Commission

July 25, 2018

Exercise Description

Task: Evaluate removal alternatives versus National Contingency Plan criteria of effectiveness, implementability, and cost for a given scenario.

Evaluation Criteria

Effectiveness: This criterion focuses on the degree to which an alternative reduces toxicity, mobility, or volume through treatment; minimizes residual risks and affords long-term protection; complies with applicable or relevant and appropriate requirements (ARARs); minimizes short-term impacts; and how quickly it achieves protection. Alternatives providing significantly less effectiveness than other, more promising alternatives may be eliminated. Alternatives that do not provide adequate protection of human health and the environment shall be eliminated from further consideration.

Implementability: This criterion focuses on the technical feasibility and availability of the technologies each alternative would employ and the administrative feasibility of implementing the alternative. Alternatives that are technically or administratively infeasible or that would require equipment, specialists, or facilities that are not available within a reasonable period of time may be eliminated from further consideration.

Cost: The costs of construction and any long-term costs to operate and maintain the alternatives shall be considered. Costs that are grossly excessive compared to the overall effectiveness of alternatives may be considered as one of several factors used to eliminate alternatives. Alternatives providing effectiveness and implementability similar to that of another alternative by employing a similar method of treatment or engineering control, but at greater cost, may be eliminated.

Potential Removal Alternatives

Alternative A - No Action: Required to be evaluated for all mine sites.

Alternative B - Backfilling Mine Workings with Contaminated Mine Waste: Backfill mine workings with mine waste.

Alternative C - Consolidation and Capping of Mine Waste in Place: Consolidate all waste into one area of the mine site and cover with a 4-ft thick evapotranspiration (ET) cover.

Alternative D - Excavation and Transportation to a Regional Repository: Excavate and move all mine waste to a repository located 5 miles away, and cover with a 4-ft thick ET cover. Note: Waste could be consolidated from other mines as well, but teams should only focus on the alternative for the one mine.

Alternative E - Off-Site Disposal at a Licensed Low-Level Radioactive (LLRW) Facility: Excavate and move all mine waste approximately 500 miles to the facility in Clive, UT, operated by Energy Solutions.

Unit Costs (made up - provided for this exercise only):

Road building:		\$10,000 per 0.1 mile
Excavation of waste:	Consolidation	\$10 per cubic yard (CY)
	Easy excavation	\$30 per CY
	Difficult excavation	\$50 per CY
Transport of waste:	Truck:	\$ 0.20 per CY per mile
Disposal Fees:	Consolidate and Cap:	\$20 per CY
(includes costs	Regional Repository:	\$30 per CY
for constructing caps)	LLRW Facility:	\$80 per CY

AUM Scenario 1 (Teams 1 and 4)

Mine Type:	Underground mine on edge of mesa
Road building required:	5 miles
Mine Waste Volume:	10,000 CY
Excavation Difficulty:	Difficult
Transport types required:	Both haul and highway trucks

Note:

- Existing studies of the mine workings indicate that this mine is not a candidate for backfilling due to collapse mine workings.
- On-site consolidate and cap would require complete excavation on the slopes and placement immediately back of the mesa edge.



Mine waste on steep slopes

AUM Scenario 2 (Teams 2 and 5)

Mine Type: Open pit mine

Road building required: 0.1 miles

Mine Waste Volume: 100,000 CY

Excavation Difficulty: Easy

Transport types required: Either haul or highway trucks

Note: On-site consolidate and cap would fall under the “consolidate” cost for excavation because much of the waste could be pushed into the pit rather than excavated and placed in trucks.



Open pit



Waste pile adjacent to open pit

AUM Scenario 3 (Teams 3 and 6)

Mine Type: Underground mine with waste accessible by road

Road building required: 1 mile

Mine Waste Volume: 1,000,000 CY

Excavation Difficulty: Easy

Transport types required: Both haul and highway trucks

Note: Existing studies of the mine workings indicate that this mine is not a candidate for backfilling due to collapse mine workings.



Waste pile from underground mine

Evaluation Worksheet (All Teams)

Alternative A - No Action

Alternative B - Backfilling Mine Workings with Contaminated Mine Waste

Alternative C - Consolidation and Capping of Mine Waste in Place

Alternative D - Excavation and Transportation to a Regional Repository

Alternative E - Disposal at a Licensed Low-Level Radioactive (LLRW) Facility

CRITERIA/ALTERNATIVE	NOTES
Effectiveness	
Alternative A	
Alternative B	
Alternative C	
Alternative D	
Alternative E	
Implementability	
Alternative A	
Alternative B	
Alternative C	
Alternative D	
Alternative E	
Cost	
Alternative A	
Alternative B	
Alternative C	
Alternative D	
Alternative E	

Remnants of Mine Blasting



- Over 50 Blasting Caps were Located in Three Areas on Mesas III and V
- Blasting Caps were Rendered Safe by Removal or were Blown in Place
- Coordination with NNEPA – CID and Farmington Bomb Squad
- Identification, Avoidance, and Communication Procedures Established



Remnants of Mine Blasting



Remnants of Mine Blasting



Project Photos

